CHEMICAL & METALLURGICAL ENGINEERING

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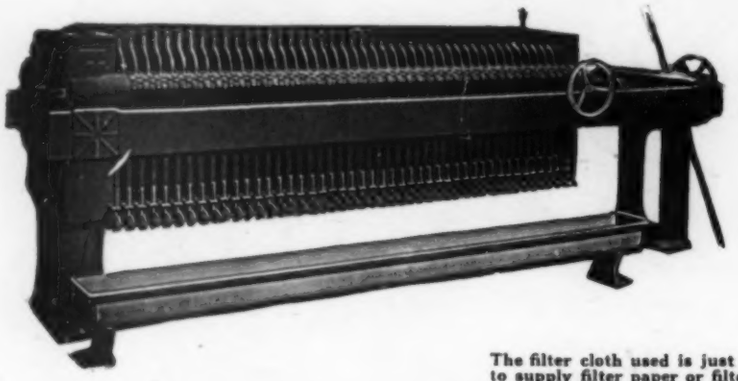

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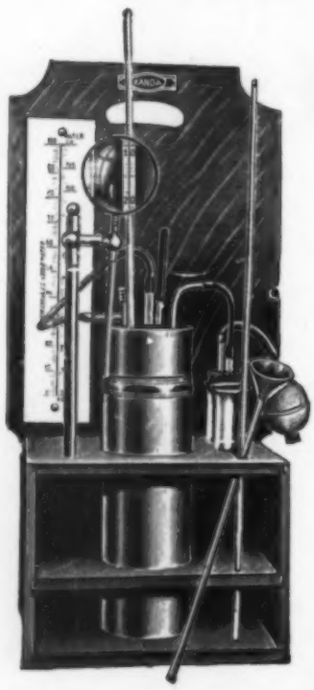

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The Outlook For Coal

DEVELOPMENTS of the past week in the coal strike demand the attention of every coal-using industry. The complacence with which the strike was faced when it started was based upon two fortunate facts. First, there was a large stock in the hands of consumers; and second, the non-union mines could be depended upon to furnish nearly the normal summer consumption. As time has passed and JOHN LEWIS has specifically refused to yield to anything but a national settlement, the situation has grown more serious. Today the country is confronted with a real coal shortage coupled with a strong demand. The certainties now appear to be that there will be no wage reductions, that high prices will prevail for another year and that federal control probably will last throughout the winter. Of course, some settlement will be reached, but it is not known how long Mr. LEWIS can hold his miners in leash. Apparently he is the key to the situation, because he has persuaded union miners that the existence of their union is threatened and that a compromise will involve its destruction. He has imbued the strikers with this thought more strongly than any other leader has been able to do and consequently his ranks thus far are practically unbroken. No acceptable form of settlement is in sight at the present writing.

Statistically the situation is about as follows: The normal summer consumption has been 8,000,000 tons of bituminous coal per week; and up to July 1 the production of non-union coal was approximately 70 per cent of this figure, or about 6,000,000 tons. The effect of the rail strike, however, which apparently was directed with telling effect in non-union coal fields, has been so successful in curtailing production that last week it amounted to only 3,600,000 tons. Stocks in the hands of consumers on April 1 amounted to about 67,000,000 tons, with possibly 10,000,000 tons in transit. On July 1 the tonnage in the hands of consumers had dwindled to 2,000,000 and undoubtedly the tonnage in transit was greatly reduced as a result of the railroad strike. Thus we are faced with stocks that represent not much more than two weeks' supply, and a non-union production of less than one-half the normal consumption.

Obviously the situation called for federal control and for the consequent creation of a priority list. In fact priorities have been established not only for the supply of coal to industry but for the transportation of commodities as well. The transportation priority list gives preference in the following order: Food for human consumption, feed for live stock, live stock, perishable products, coal, coke and fuel oil. Coal will be furnished to industries according to the following priority list: Railroads, ship bunkers, public utilities directly serving the public, electric power and light, gas, water and sewer works, ice plants, hospitals, government institutions, and lastly, "all other purposes," which includes iron and steel and allied industries. This suggests a possible advantage to those industries that buy power from a utility corporation.

Federal control has already shown an increase in the production and movement from non-union fields, amounting to about 20 per cent in the first week. Prices are stabilized and every effort will be made to prevent a runaway market. On the whole the situation is critical and will demand the most careful consideration on the part of consumers. Of the present non-union production of 4,000,000 tons about 3,250,000 tons will be allocated to utilities under the priority list, leaving less than one million tons per week for all other purposes. It is expected, of course, that this production will increase under federal control even if the strike continues. In the event of the resumption of mining in the unionized fields, it is probable that full production and distribution can be accomplished in 30 days. But even then it must be remembered that stocks have dwindled so low that there will still be the effect of a shortage long after full production is resumed.

The Value of Chemists' Clubs

WHEN the late Dr. MORRIS LOEB made the Chemists' Club of New York a living thing, he may have guessed—and again he may not—that many other chemists' clubs would spring into being, following the New York example. The fact was demonstrated that chemists are social beings and that, as in other agencies, there is great value in informal discussions. When chemistry was purely experimental in its nature, there appeared many reasons for workers in the field to keep what they knew to themselves and not to talk too much, lest some fact which the talker had observed might also be noted by somebody else before the former had profited by it in credit or in money. But now that chemistry, thanks to the introduction of physics into chemical thought, is becoming more and more of a deductive science, we—or at least a great many of us—need help and inspiration and jogging along in making our deductions. We need to talk things over, and the royal road for this purpose, to the man who is at once sympathetic and trustworthy, is by way of the club.

Our readers know of the Chemists Club at Chicago, we lately referred to the civic activities of that at Tacoma, Wash., and there are others in various parts of the country, some active and some inactive. Our present purpose, however, is to tell a little of the Chemical Industry Club of London, which is taking its place as a well-known feature of the professional life of chemists in England. Its quarters are in Whitehall Court, which is an institution of itself and is operated

by the same company that manages the Hotel Cecil. This Whitehall Court overlooks the Victoria Embankment and the Thames River, near the houses of Parliament and Westminster Abbey, and it provides sleeping rooms for the members and guests of a score or more of various clubs which it houses. Meals are served in the Chemical Industry Club rooms and in a common dining room, and one may, through his club facilities, also lodge his family in this very agreeable place. It is not available to the public, the charges are moderate, and the service excellent.

The club itself is small and has had the same trouble that the New York Chemists' Club had in the beginning of its career, in getting members to drop in and make themselves at home. But that phase is passing away, and now every table is often taken for luncheon, while at "the cocktail hour," from 5 to 7, one is sure to find a number of members.

The reciprocal arrangements between the Chemists' Club of New York and the Chemical Industry Club of London are a great convenience to the members of each. Membership in one is an introduction to and a warrant for the privileges in the other. None but an offensive and churlish person could miss the cordial welcome and good will that is thus extended to the American chemist in London, and we believe the same holds good of the English chemist in New York. At least, one hears abundant testimony to that effect. These things speak well of the chemical profession; indeed, we know of no other professional calling that provides this international reciprocity. It gives the chemist who has "arrived" far enough to be elected to membership the access to the eminent men in his own walk of life, both at home and abroad, and it adds charm to the profession.

A Rebuke To Insolence

PRESIDENT HARDING never was in better form than last week when he administered a well-merited rebuke to one J. CLEVE DEAN, who, signing himself as Chairman Railroad Employees' Publicity Association, addressed an insolent letter to the Executive. The Dean letter was filled with statements which the President rightly characterized as ungrateful and untruthful. Mr. DEAN indulged in silly sentimentalism when he stressed the strikers' loyalty and war service on European soil. He resorted to a cheap gesture in an effort to becloud the government's action when he warned against any "attempt to draft men into mining or railroad service." He made an idle threat when he predicted that under the government's "attempt to place American labor under the gun, nothing short of a revolution will happen." The President answered these vaporings "with that contempt which is felt by every good citizen in the hour of deep public concern."

There has been far too much loose talk on the part of labor leaders in the present strikes. Mr. DEBS was so incendiary in what practically amounted to a call to arms that most good citizens felt the government would do well to invite him to resume his residence in Atlanta. Mr. LEWIS has talked glibly of the government's use of troops as an "assembling and parading of engines of war to awe American citizens who are merely exercising their inherent constitutional right to cease work." Such words can be uttered only in insincerity and disloyalty.

Mr. GOMPERS has recently repudiated the Dean letter and has announced that there is no such individual. He expressed surprise that Mr. HARDING would answer the letter, but we believe that the country will be grateful to him for speaking as he did. Whether Mr. DEAN is a real or fictitious character, the sentiments expressed in his letter have characterized all too freely the utterances of other leaders who are not mythical characters. It is of no moment whether Mr. DEAN exists or not, but it is a source of gratification to a long-suffering and law-abiding citizenry to have the Chief Executive voice public sentiment in so decisive a manner.

Stabilizing Germany's Financial Affairs

GERMANY'S financial affairs are in such a hopeless tangle that we often catch ourselves bracing momentarily for a crash that seems inevitable. But for some reason or other it never comes. Not long ago when the news of Baron RATHENAU'S assassination caused the paper mark to tumble down to 18 cents a hundred, we thought the fall would surely prove fatal. But it didn't, even though it did represent a depreciation of considerably more than 99 per cent. Just where the endpoint lies we know not, but it seems certain that when the Germans themselves repudiate the mark an economic paralysis of all Europe is bound to follow.

It is no wonder then that the financial experts of England and France, in fact of the whole Reparations Commission, are giving serious concern to this problem. But even the layman can see that there are at least two things wrong with Germany's financial system that must be corrected. In the first place the printing press that has been inflating Germany's floating debt —sometimes at the rate of 10 billion marks a week— must certainly be stopped. And secondly, someone must put an end to the exporting outside of German borders of capital and every other movable thing of value. These are basic requisites for any lasting solution of Germany's troubles. The partial remission of the reparations debt and the floating of a German loan are important and essential, but these things take time and there are plenty of reasons to believe that they may come too late.

The proposal recently put forward by the Guarantees Committee of the Reparations Commission is basically sound in that it goes to the real sources of these difficulties. Under this plan two overseers from the Reparations Commission are to be accredited to Germany's Finance Ministry; one is to watch over income and the other over the outgo. These representatives of the Allies are to have access to all of Germany's finances. The floating debt, the budget, tax and customs receipts, imports, exports and all economic and financial dealings of the government are to be watched over by them. Here, however, is the inherent weakness of the plan, for the overseers must act in a purely advisory capacity. They are merely liaison officers between the Finance Ministry and the Reparations Commission and are not empowered to put into effect the reforms that the latter body may deem necessary. But, on the whole, this is a step in the right direction and the German Chancellor wisely sees in it a stabilizing influence that may help to bridge over the gap until a reasonable idemnity is definitely settled and reparations thus changed from a political controversy to an ordinary business debt.

In the meantime it seems that there is every chance

that favorable developments will come from the meetings of the French and British Premiers. France, which previously has been insisting on conditions that have made an international loan impossible, has apparently agreed that reparations shall be reduced from 132 to 50 billion gold marks providing Great Britain is willing to forgive the French debt. This tackling of the problem of interallied debts in relation to reparations is admittedly a ticklish proposition, which was put off at Genoa, The Hague and elsewhere largely because of America's attitude toward cancellation. The decision to go ahead independently of the United States would seem to be the first really constructive step that France and England have taken in their own behalf.

We are not going to take sides on the cancellation question, for it is not an issue with which we are concerned—as yet. But it is our contention that every American industry should be interested in stabilizing money values in Europe and can well lend its support to any scheme that will make Germany a solvent purchaser of American goods and at the same time do away with the advantage which the greatly depreciated mark allows her in the world markets.

Wage Fixing By Numbers

DURING the school days of some of us, and at a relatively earlier time as regards others of us, there was published a book "Looking Backward" by EDWARD BELLAMY. The narrator was supposed to be an insomniac, who spent his nights hypnotized in an underground chamber, was lost track of when a great fire obliterated the approach to the chamber and was resuscitated long afterward when the United States had become a socialistic state. It was a great book to fire the imagination of those who had little experience in ways of the world and traits of the human mind.

In this imagined socialistic state everyone had the job for which he was fitted. The narrator was assigned the task of telling the people of the new generation how men lived and behaved themselves at the time he had got lost in his underground chamber. What startled the new people most was the low price of votes. In the new time, votes had become so valuable, on account of the amount at stake, that men would not sell them, and the most intelligent and fairest minded men got elected. One of the duties of the officials, of course, was to prescribe how much work each person had to do in order to be given his fraction of the total production of commodities, etc.

We have had enough of developments of late to suggest how a socialistic state would work with men constituted as they are. Some of the advocates of the socialistic principle have urged that it could be applied gradually to one thing after another. We find labor unions in existence, and the unions involving crafts that employ large numbers of men are conspicuous for the high wages they demand in proportion to the amount of work done. If in the socialistic state votes could not be bought for a dollar or two apiece, as BELLAMY intimated was the case in his time, would not the classes of voters, by trades, that were in the largest numbers be most influential with the official who allotted the jobs? Is it not probable that if it required two million men to do a certain kind of work that craft would receive the highest wages, the craft involving only a million men somewhat lower wages, the craft counting up only a hundred thousand much lower wages, and the crafts having only a few members very low wages indeed? The actual difference might not be in wages. It might be in working rules, in hours of labor or in various other devices.

The condition observed today is a parallel to that of BELLAMY'S socialistic scheme. If there are only a thousand of a certain craft in the country, their going on strike makes little trouble. The trouble can probably do without their work for a while, or their places can be filled. If the craft requires a million men the strike soon affects the public, and it is difficult to fill so many places. In brief, it is a bad principle to live under, yet it looks very much as if we are expected to do so.

Does Your Roof Leak?

IT WAS RAINING and the shiftless tenant had just moved his chair a few feet so that the water from the leak in the roof would not drip on him.

"Why don't you fix that roof?" asked a stranger who happened to drop in.

"Well," drawled the tenant, "when it's raining you can't fix the roof, and when it's dry you don't need to fix it."

This remark is justly famous and perhaps we can draw from the story a legitimate parallel with conditions in chemical manufacturing. Not long ago at the convention of the National Fertilizer Association, its president admitted a lack of interest in research. He said that at the present time the industry can buy nitrogen either as nitrates or as sulphate of ammonia more cheaply than it costs to manufacture it synthetically. Therefore, it is not greatly exercised about research in synthetic ammonia or nitric acid. Interest was expressed in the work which the government was doing on phosphoric acid, but the fertilizer maker was not sufficiently excited about it, at least not to the point of spending any money on the problem. In other words, the fertilizer industry sits under a roof which needs patching badly and says: "What's the use of mending it, it isn't leaking now." The sequel to this may be that in five, ten or fifteen years when the fertilizer industry is buying synthetically produced nitric acid, ammonia and phosphoric acid at prices which the manufacturers of these commodities happen to demand they will have no cause for grievance on the subject. In fact it would not be at all surprising if manufacturers of synthetic nitric acid, ammonia and phosphoric acid would displace the present makers of fertilizers.

The fertilizer industry is not by any means the only offender, but it is a large and important one. Manufacturers of dyes in this country are beginning to lie back on their somewhat faded laurels. The minute they curtail research their roofs begin to leak, for dye making demands the most vigorous research of any industry.

It is the same old moral and we feel a little like the Scotch preacher who kept preaching the same sermon to his congregation. After the fifth or sixth repetition one of the elders of the church asked him why he didn't tell them something new, whereupon the wily pastor replied: "When you begin to live up to the message of this sermon, then I'll begin to think about a new message." So it is with chemical manufacturers. When the day comes, though we suppose it never will, when all chemical manufacturers understand and appreciate the vital nature of research work, then we shall stop harping on the old refrain. Meantime, is your roof leaking?

Kotaro Honda, Bessemer Medalist

AT THE annual May meeting of the British Iron and Steel Institute, the Bessemer Medal was awarded to Dr. Kotaro Honda, the Japanese scientist, in recognition of his researches into the magnetic properties of iron and steel.

Dr. Honda was born Feb. 23, 1870, and was graduated in the physics department of the Tokyo Imperial University at the age of 28. He remained in that institution for 10 years, doing post-graduate work and lecturing in physics. At the end of 5 years he received the degree of Doctor of Science. Much of his time was taken up in the study of magnetic phenomena, and several of his papers on magnetism appeared during the time he was at the Tokyo Imperial University.

The years 1908 to 1912 were passed studying in Berlin, Göttingen and Paris. In Berlin the magnetic susceptibilities of various chemical elements were studied in the private laboratory of the late Prof. H. du Bois. Dr. Honda's first work as a metallurgist occurred under Prof. Tammann's direction, in Göttingen, where he investigated the structure of metals and alloys.

In February, 1912, he returned to Japan, having been appointed professor of physics at the newly established Tohoku Imperial University at Sendai, a city of 100,000 inhabitants situated toward the northern end of the main island. The Iron and Steel Research Institute—of which more will be said later—was established in 1919 with Dr. Honda as president. Since that time his attention has been divided between the university and the Institute.

KOTARO HONDA, BESSEMER MEDALIST

The new Bessemer Medalist has an astonishingly fertile pen. Ever since his graduation he has been constantly investigating the problems of magnetism, both in theory and experiment. Forty-one scientific papers, written in English or German, contain the results of these studies. From a strictly utilitarian point of view his labors are more important for the development of a magnet steel of superior qualities. During his first 8 years after graduation Dr. Honda was also concerned with some geophysical problems, such as seiches (stationary undulations) in lakes and bays, geysers, and the periodic changes in level in deep wells—studies which resulted in nine papers written in English. Since his return to Japan in 1913, he has been chiefly concerned with problems in physical metallurgy of iron, steel and other alloys, and has written thirty-six papers recounting his findings, all of which have appeared, either as originals or reprints, in the *Science Reports* of the Tohoku Imperial University. Dr. Honda and his associates developed a method for studying changes in the magnetism of a metal as the temperature varies. Using this new tool, researches into the constitution of plain and alloy steels have been able to furnish a great amount of information on hitherto unsolved problems. Of these, perhaps the most notable are extended investigations into the constitution of chromium steels, tungsten steels and tungsten-chromium (high-speed) steels. Beyond all this, Dr. Honda has found time to publish several books in his native language: an 800-page Text Book on Physics for high school students; a similar but shorter volume for university students; a 320-page monograph on Magnetism and Matter; and three short brochures on certain investigations of iron and steel.

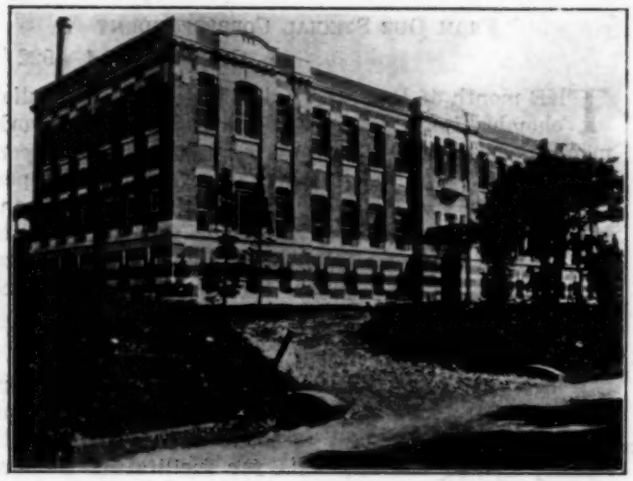
In addition to the Bessemer Gold Medal, Dr. Honda has received the Gold Medal of the Institute of Electrical Engineers of Japan, the Gold Medal of the Institute of Mechanical Engineers of Japan, and the Academy Prize of Japan, consisting of a medal and a grant of money. Dr. Honda, in addition to his duties at Sendai, is a member of the National Research Council of Japan and of the Aëronautical Research Institute of Tokyo.

Notes on the establishment and present scope of the Iron and Steel Research Institute may best be given in Dr. Honda's own words:

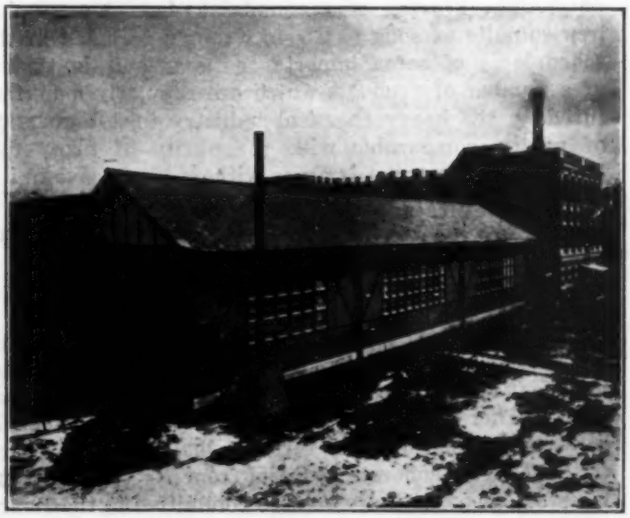
"The foregoer of the Institute, a temporary research institute for physics and chemistry, was started under my supervision in 1916 amid the great war with a personnel of six and an annual budget of 7,000 yen only, for the investigation of iron and steel. This budget was subscribed by Baron K. Sumitomo, of Osaka, Japan. Two years later, when research had been recognized by the public as very useful for the progress of science and industry, it was decided that the Institute should have a permanent organization.

Fortunately Baron Sumitomo again offered a donation of a building [shown in two views on the next page] and its equipment to the government; the latter agreed then to establish a permanent research institute for iron and steel belonging to the university. In 1919 the government organization was established with an annual budget of 50,000 yen and a staff consisting of the president, two research professors, five assistant professors, nine assistants and three mechanics.

"In 1921 an extension of the Institute was again undertaken by the government. It is to be completed



FRONT VIEW
IRON AND STEEL RESEARCH INSTITUTE



BACK VIEW
WITH SHOPS AT REAR OF INSTITUTE

in the three years from 1922 to 1924; the Institute is henceforth enabled to investigate not only iron and steel, but also non-ferrous metals and alloys. The contingent outlay amounts to a total of 240,000 yen; the annual budget for 1922 is 90,000 yen, for 1923, 130,000 yen, and for 1924, 170,000 yen. After three years, when the organization is completed, the staff will consist of the president, four research professors, twelve assistant professors, twenty-seven assistants and twenty-five mechanics, etc.

"Though my institute is almost insignificant in its scale compared with a similar institute of metallurgy in your country, such as that in the Bureau of Standards, yet this is the only national research institute in our country—a miserable state from the scientific viewpoint."

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

THE annual meeting of the Society of Chemical Industry has already been described by Dr. Hendrick and the chemical portion of what has this year been a veritable American invasion has, if rumor is correct, had every opportunity of comparing "dry" states with, for example, dry sulphate of ammonia as made in Scotland. A British contemporary draws attention to the apparent lack of a constructive and progressive policy on the part of the society. Although there has certainly been a "tendency toward routine and repetition" this charge cannot be laid at the door of the Chemical Engineering Group, whose sessions were an outstanding feature of the convention, and in more than one quarter it was suggested that this was a case of the tail wagging the dog. Experienced observers of British character, however, realize that new developments are often initiated without warning and it is by no means improbable that the society may already have something up its sleeve.

SPENT OXIDE INCREASINGLY USED IN ACID WORKS

Many sulphuric acid plants had to burn sulphur instead of pyrites during the war period, but the partial return to more normal conditions of working has been delayed by the lack of demand for acid. Spent oxide has been accumulating at the gas works, partly because some of them found the manufacture of anhydrous ammonia more profitable than that of sulphate. These conditions have reacted upon each other to keep the price of acid abnormally high and the revenue from the sales of spent oxide has been insufficient to offset the purchases of acid. As a result there is a tendency to use spent oxide, sometimes enriched with sulphur, instead of arsenical cuprous pyrites, with all its attendant disadvantages and the subsidiary processes required for the manufacture of the superior grade of acid. The position will probably gradually adjust itself, but it is unlikely that the use of pyrites will again reach its former dimensions. Ammonia oxidation equipment for sulphuric acid manufacture continues to find favor, particularly in the larger works and for coke-oven installations; several firms are now able to supply standard equipment.

POLICY OF THE BRITISH DYESTUFFS CORPORATION

The annual meeting of the British Dyestuffs Corporation indorsed by a very substantial majority the policy of the directors and was a personal success for Sir William Alexander and his claim that the directing head of such an undertaking should be primarily an administrator with experience in administration of similar undertakings. Dr. J. G. Burnham, who will be remembered as the general works manager of the Gretna munitions factory, will act in a similar capacity to the corporation, and the research department will be continued as before under Professor Green and Mr. Baddiley. It is frankly realized that the corporation has a difficult task before it, but it is already evident that the very straightforward statement of the present position, the radical cutting down of expenses and inventories, and the improvement in quality of colors and in cash assets have restored a large measure of confidence in the future, particularly as personal issues have now been largely eliminated. Referring to the key industries act, it has been decided that boracic acid was wrongly included in the schedule and it will cease to be treated as a fine chemical and will be exempt from

duty. The hearing of a complaint that photographic hyposulphite of soda has been wrongly included in the schedule is of some importance because it is typical of a number of products which are regularly manufactured by the heavy chemical industry in a high state of purity, comparable with the purity of many fine chemicals. A prophet is never without honor save in his own country, but on the basis of recent decisions it is expected that the duty will be removed or a compromise reached.

Proposed Advisory Scientific Committee

Until it was realized that scientific advice was indispensable for the Munitions and War Departments, technical advisers were at a discount for political purposes. There is again a tendency to drop the scientific pilot, and it has brought forth in the form of a letter to the *Times* a concrete proposal from Sir William Pope to establish an advisory science committee to the Board of Trade. There is no doubt that this country has lagged behind other countries in the movement for establishing a system by which the government can consult not only the trades concerned but also more impartial experts before introducing half-baked legislation or regulations, and so avoid their inevitable reconsideration when subsequently criticized or actively opposed. It is felt, however, that liaison with science is essential not merely for the Board of Trade but also for other government departments, and that the continental system of registering scientific legal assessors and attaching them to the courts of law has much to recommend it. Something has already been done in connection with the administration of the dyestuffs and of the safeguarding of industries acts, but there is a dangerous tendency always to put the burden upon the same set of men, instead of spreading these responsibilities and diversions from normal activities to include some of the more active, if less experienced, specialists.

Industrial Devepopments and General Notes

Ransomes, Sims & Jefferies, of Ipswich, are now manufacturing the Kestner water tube boiler in this country and a brief reference may be appropriate as illustrating the way in which what might almost be termed a chemical engineering problem—hitherto an untrodden preserve of the chemical engineer proper—has been invaded by one of the world's leading chemical engineers. The Kestner boiler is the direct outcome of experience in connection with the evaporation and concentration of chemical liquors and resembles a standard evaporator except that the vertical tubes are arranged in the form of a double *W*, over which the flue gases take a zigzag path. To promote circulation, a number of the tubes are made of larger diameter and inside them are fitted smaller concentric tubes supported by spiders. In actual practice it is found that very little scaling takes place with normal waters, tubes can be replaced very easily and, the lower drum being freely suspended, all tubes are free to expand. An interesting feature is the possibility of combined gas and fuel firing, and it is understood that efficiencies of about 80 per cent have been obtained in practice with an evaporation of about 7 lb. of steam per sq.ft. of heating surface. The Kestner company in England has recently become the sole licensee in Europe of the Merrill process of industrial heating by oil circulation, originally developed in America.

Italian Chemical Industries

From Our Special Correspondent

Genoa, July 4, 1922.

THE month of June was full of upsets for the Italian chemical industries. The agitation among the workmen continued. But there was very little actual discontinuation of work and in the case of some soap, perfumery, shoe cream, match, beer, mineral water and superphosphates works, an agreement was reached with the workers that was followed on July 2 by a general contract of work in Liguria, Piedmont, Lombardy and Tuscany.

Petroleum Supplies

A new large firm has been formed for the development of petroleum in Italy and abroad. The Italian Government did its best to make arrangements with Russia, Poland and Rumania for facilitating the importation of petroleum from these countries, and three separate agreements were signed. The exploitation of the petroleum deposits available in Italy itself was also encouraged. The imports of this product during the last half of 1921 reached 64,636 tons, and those of gasoline 57,437 tons.

Caustic Soda

The Italian production of caustic soda continues good, and it is gradually being extended. The products are more easily obtained on Italian markets than in the past and are nearly always offered at much lower prices than the imported products. This production is, however, unfortunately still small in comparison with what would be required in Italian industry.

Tanning Materials

For assisting the leather industry, that is passing through a very severe crisis, the works producing tanning materials, and especially chestnut extract, kept their quotations low and their behavior was appreciated by the tanners that produced most of their leather through the use of this extract. The Italian producers of mimosa, oak bark and other extracts could increase their production by such procedure as well as making some exports. During the last half of the past year the exports of liquid tanning extracts reached 3,331 tons, and the exports of dry tanning extracts 613 tons; whereas imports of 219 tons of liquid extracts and 1,893 tons of dry extracts were noted.

Fertilizers

The demand for superphosphates, nitrate of soda and nitrate of ammonia was small, whereas a certain activity was noted with cyanamide, Thomas slag, sulphate of ammonia, chloride of potash and sulphate of potash. The imports during the last 6 months of 1921 were as follows: 18,625 tons of mineral and bone superphosphates, 4,075 tons of Thomas slag, 3,324 tons of nitrate of soda, 11 tons of calcium cyanamide, 609 tons of sulphate of ammonia, 3,662 tons of potassium fertilizers.

New Combination for Producing Tartaric Acid

The fusion of the firms Società Appula, of Bari, Società Italiana dei Derivati della Cellulosa, of Milan, and Società Anonima Acido Tartarico, also of Milan, has taken place, forming one large firm with a capital of 25,000,000 lire.

Handling the Finished Products of Industry—IV*

By Graham L. Montgomery

Handling in the Beverage Industry Consists of Handling Empty Bottles to the Filling Machines and Filled Bottles Away From These Machines —This Handling Is Essentially One Problem — Methods Used by the Beech-Nut Packing Co.[1] to Solve It

HANDLING equipment, in a beverage industry which bottles its own product, is an economic necessity. The cost of the labor required to perform this handling without the aid of automatic equipment is out of all proportion to the possible selling price of the beverage. As a result, all successful manufacturers of beverages use handling equipment in so far as they are able to make it fit in with other economic factors in their plants.

Reference to Article I of this series shows the handling equipment for finished products divided into three general classes: First, for handling bulk or unpacked products; second, for handling finished products packed in various kinds of containers; and third, automatic machines for handling the finished product through various processes such as packing, wrapping and filling.

Handling of Bulk Product

Handling of the first class, in soft drink manufacture, consists of handling by pipe line—using gravity head where possible and in other places using pumps. This is because the finished product is all liquid. The last actual process of the manufacture of a soft drink consists of mixing the flavored sirup and the charged water. This occurs exactly at the completion of the first class of handling, when these two finished ingredients are mixed in the bottles. Here we have an exception to the general rules laid down in the first paper of the series—for normally the manufacturing processes are all completed before any operation is encountered which can be justly classed as finished product handling.

Handling of the Second and Third Classes

In bottling a beverage, handling comprised in our second and third classes must be considered as one general process—from the handling standpoint. Here we find that the handling starts with the empty bottle and the empty case, and moves from this point in a continuous path through the operations of preparing the bottle for filling, filling the bottle, sealing, testing and labeling the bottle, packing the bottles in cases for shipment, and moving the filled cases to shipment or storage.

This succession of operations is essentially one problem, the crux being to feed the bottles to the filling head and to take them away from this machine in such a way that its maximum capacity shall be realized. In this paper we shall consider the handling problem of the beverage industry from this point of view.

Beverage Handling at the Beech-Nut Packing Co.

The manufacture of beverages at the plant of the Beech-Nut Packing Co. was described in *Chemical & Metallurgical Engineering* for July 26, 1922. In that paper a description was given of the operation of the automatic equipment as it affected the product. It will be shown here in what manner this automatic equipment ties in with the conveying equipment to make a continuous process of the bottling.

Bringing Empty Bottles and Cases Into the Plant

This plant owns its own box factory, in which the cases are made. Bottles are purchased on contract from various large bottle makers.

Both of these articles are brought to the plant in box cars. Fig. 1 shows several of these cars on the siding along the receiving platform. A car of empty cases is placed near the center of this platform, with a car of empty bottles on its right. A portable gravity roller conveyor is placed to lead from the car of cases to the stationary gravity roller conveyor, which leads along the platform. Another portable gravity roller conveyor is placed to lead from this stationary conveyor to the car of bottles. A third portable conveyor is placed to lead from the car of bottles to a point on the stationary conveyor further toward the right and lower down.

The car of cases is then unloaded onto the conveyor.

*Previous articles in this series have appeared in *Chem. & Met. Eng.* as follows: Article I, vol. 26, No. 18, p. 823, May 3, 1922; Article II, vol. 26, No. 19, p. 885, May 10, 1922; Article III, vol. 26, No. 24, p. 1,114, June 14, 1922.

[1]An article descriptive of the process used in the ginger ale plant of the Beech-Nut Packing Co. appeared in *Chem. & Met. Eng.*, vol. 27, No. 4, p. 150, July 26, 1922.

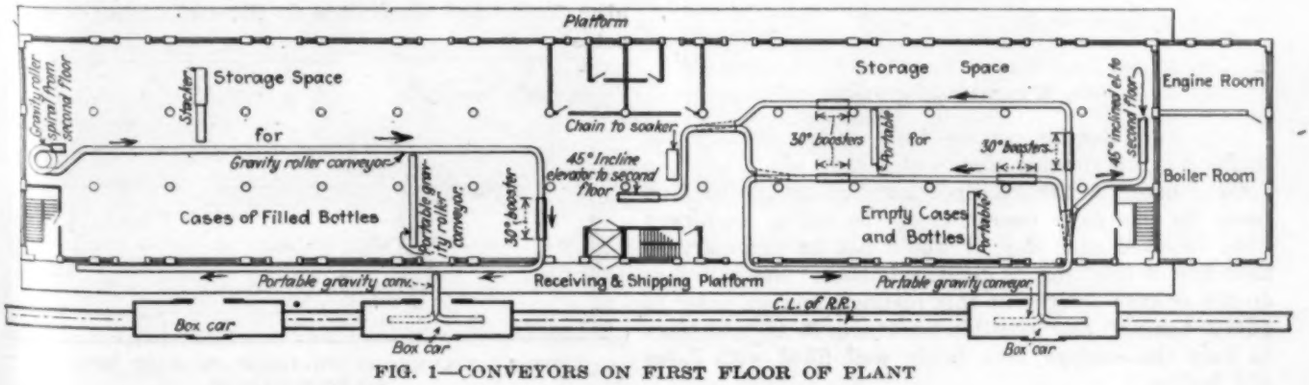


FIG. 1—CONVEYORS ON FIRST FLOOR OF PLANT

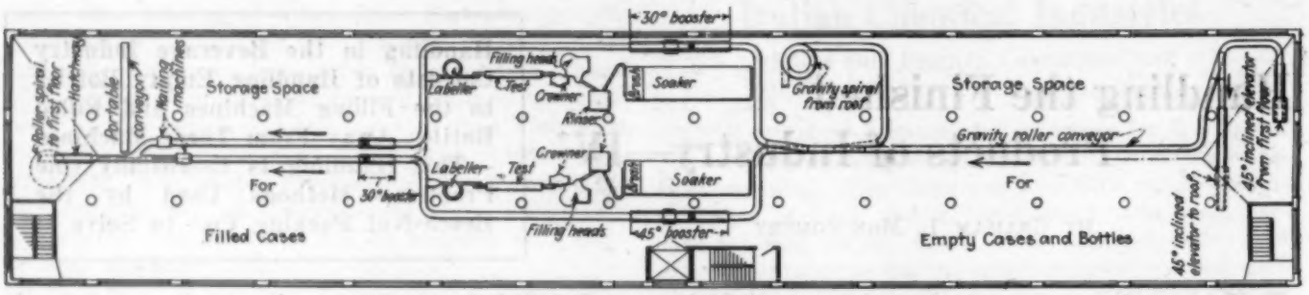


FIG. 2—CONVEYORS ON SECOND FLOOR OF PLANT

The conveyor takes the cases to the car of bottles. Here the workers fill each case with the empty bottles and place it on the third portable conveyor. This conveyor takes the cases back to the main gravity roller conveyor line and they are distributed from this line to the various storage areas for empty cases and bottles.

Storage System for Empty Cases and Bottles

By referring to Figs. 1 and 2 it will be noticed that the floor area at the right side of each drawing is marked "Storage for Empty Cases and Bottles." The space on the roof—shown in Fig. 3—is also used for this same purpose.

As the cases full of empty bottles pass into the building—at the right or east end as shown on the sketch in Fig. 1—they may be directed by means of the three-way switch to any of the storage areas mentioned above. The cases are stacked about 10 ft. high in these areas. It has been found inadvisable to use stacking machines to any great extent, as the same crew that would be used in connection with a stacking machine can stack these light cases more quickly by hand methods. The total floor area of these several storage spaces is about 18,000 sq.ft.

The gravity conveyors used in this system are at no point so high that the workers cannot easily remove a box. For this reason and due to the slope allowed in the conveyor for the purpose of causing the cases to move along it, it is necessary to provide power conveyors at intervals, as shown on the sketches, in order to boost the level back to a point where gravity can again be employed. These boosters, inclined at 30 deg. to the horizontal, are inclined package elevators of the push-bar type. They are made up of bars spaced at about two-case intervals and carried between two power-driven chains. The bed on which the cases slide is of steel slats parallel to the travel of the cases. Several of the photographs used to illustrate this paper show these boosters clearly. The elevators which take cases from one floor to another are of the same type, but are inclined 45 deg.

Conveying the Empty Bottles From Storage to Washing Machines

Before the bottles can be filled, it is necessary for them to be thoroughly cleansed.

Of course, if the required number of bottles and cases for one day's operation of the filling machinery were received each day, it would not be necessary to have any of this storage described above. But railroads do not deliver freight in this manner, and in order to guard against any possible shortage it is necessary to keep the storage area fairly well filled with cases and bottles.

The conveyor which distributes the cases to the storage areas on the roof—shown in Fig. 3—is continuous and also serves to take these cases out of storage. When it is desired to do this, the cases are placed on the conveyor and the conveyor leads them onto the roller spiral conveyor shown in the upper left corner of this sketch. This spiral conveyor, together with a short run of gravity at its lower end on the second floor, delivers the cases with their load of empty bottles to the second floor conveying system.

Out of Storage on the First and Second Floors

The bottles are carried through the soaker—which is the first element of the washing machinery—on a conveyor. While the soakers are situated on the second floor, the conveyors that feed them loop down to the first floor, so that the bottles which are to be washed may be fed in on either floor. This serves the purpose of permitting the storage of bottles from cars into the storage spaces of the second floor and roof at the same time that bottles are being taken from storage on the first floor to feed the soaker conveyor.

It will be noticed from the sketches and from the accompanying illustration that the gravity conveyors which handle the empty bottles have, in each case, on both the first and second floors a length passing directly in front of the soaker conveyor. The cases, each with its load of empty bottles, are taken from storage and placed on a line of conveyor which leads either to the first or second floor soaker loading station; or, if used directly from the cars, they are routed over the central run of conveyor to the loading station on the first floor as shown in Fig. 1.

Handling Bottles Through the Washing Process

The conveying element of the soakers, as can be seen in the photograph, consists of two steel bar power-driven chains, which carry the bottle holders spaced at regular intervals. The soaker tenders stand between the gravity conveyor and the front of the soaker. As the cases come along the gravity conveyor, they remove the bottles and place them in the compartments of the

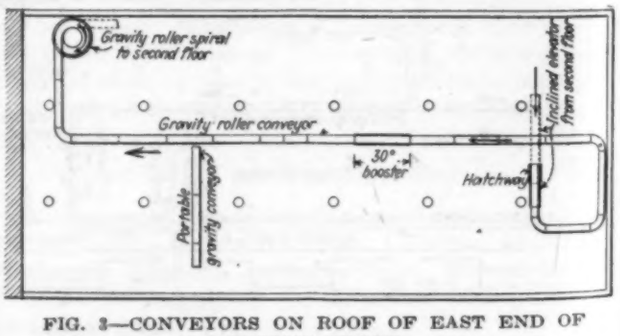
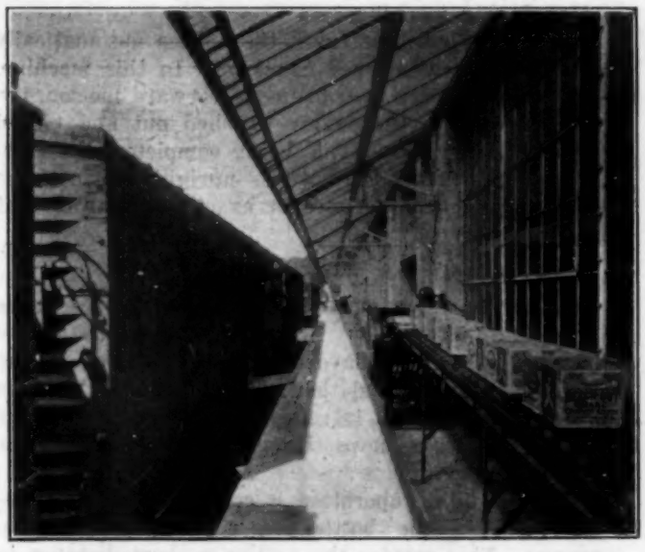
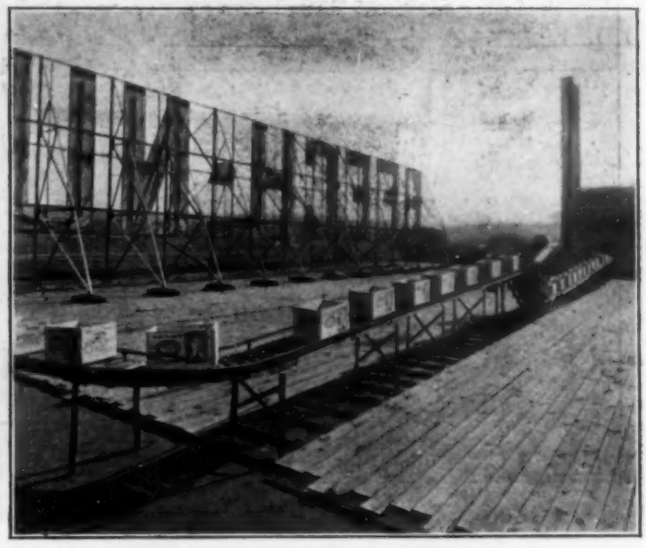
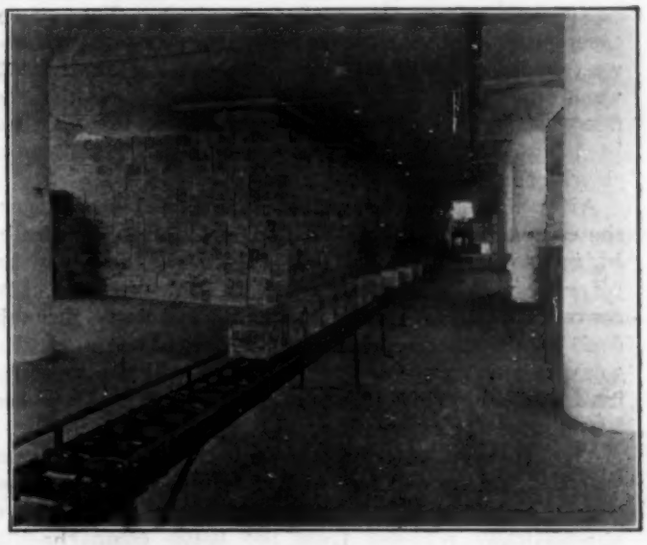
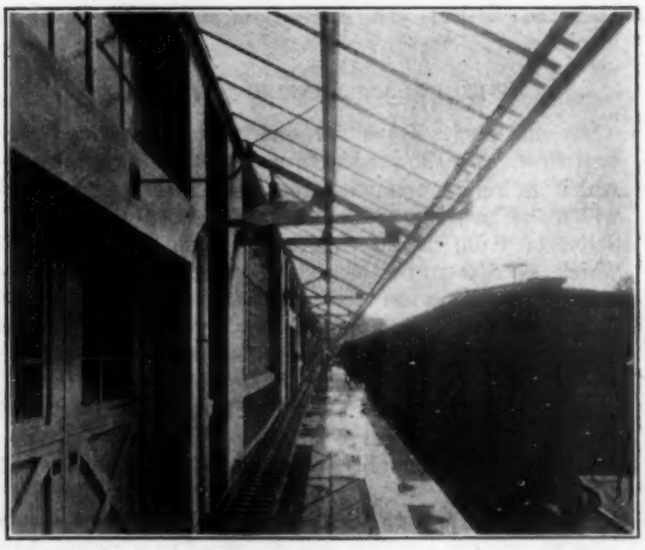


FIG. 3—CONVEYORS ON ROOF OF EAST END OF SECOND FLOOR









UPPER LEFT—RECEIVING CONVEYOR ON PLATFORM

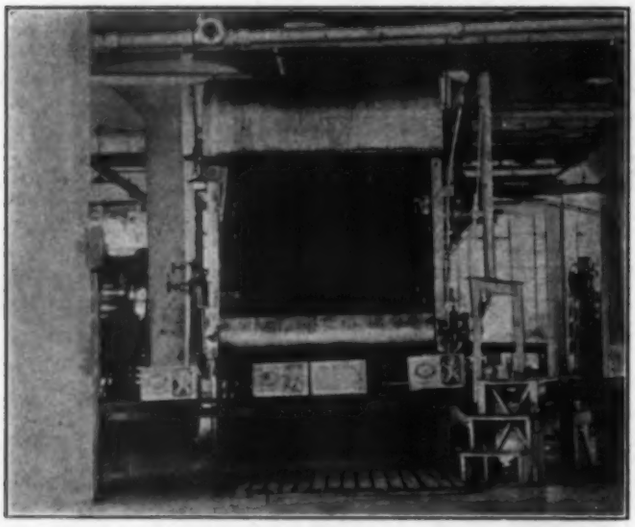
CENTER LEFT—CASES AND EMPTY BOTTLES ON SECOND FLOOR CONVEYORS

LOWER LEFT—CASE-FILLING STATION

UPPER RIGHT—DELIVERING CASES TO ROOF STORAGE

CENTER RIGHT—CASES AND EMPTY BOTTLES ON FIRST FLOOR CONVEYOR

LOWER RIGHT—SHIPPING CONVEYOR ON PLATFORM



GRAVITY CONVEYOR RUNNING IN FRONT OF SOAKER

bottle holders on the soaker conveyor. The empty cases continue along the gravity conveyors toward the west or left end of the building—passing around the washing, filling and other machinery—meeting the filled bottles at the point where these are to be loaded back into the cases. Reference to Fig. 2 will show clearly this routing.

After the bottles are placed in the soaker conveyor, the compartments in which they rest are automatically barred so that each bottle is held firmly and may be reversed without spilling from its compartment. The conveyor then carries the bottles up and down through each of three compartments filled with warm caustic solution and two compartments filled with warm sterilized water. This process—called soaking—requires 30 minutes for completion.

The conveyor, with its load of bottles, emerges from the soaker near the top and traveling straight downward. Part way on its downward path the bars are automatically removed from the bottle compartments and the bottles are discharged into the brushing machine.

Brushing and Rinsing the Bottles

As the bottles leave the soaker conveyor they slide, butt first, into the brushing machine. This machine—which is really one with the soaker—is of the same width and has a separate channel or path for each bottle delivered from the full width of the soaker conveyor—which is fifteen bottles wide. These channels slope sufficiently to cause the bottles to slide under the brushes. From that point they are moved forward mechanically, being rotated on their axes while passing under the brushes. These brushes rotate horizontally on axes at right angles to direction of bottle travel. These two motions serve to clean the outside surfaces of the bottles thoroughly, removing any old labels which adhere.

Passing beyond the brushes, the bottles are moved into an upright position and delivered to a single-chain conveyor traveling at right angles. This conveyor is made up as follows: The chain is a steel roller chain, carried on sprockets rotating in the vertical plane. The top strand runs between guides. The links of the chain carry steel plates in such a manner as to make a moving platform between these guides. On this moving platform the bottles are carried upright and in single file to the rinsing machine.

The rinsing machine takes the bottles automatically from the above-mentioned conveyor. In this machine, while the bottles are in continuous forward motion, the inside of each is thoroughly brushed out and rinsed with sterilized water. This being completed, the rinsing machine delivers the bottles—upright and in single file—to a single-chain conveyor exactly similar to that described above.

Filling and Crowning the Bottles

This last conveyor moves the bottles a short distance to the filling machines. There are two of these, the "siruper," where the flavoring sirup is placed in the bottle, coming first and then the "filling-head," where the charged water is introduced and mixed with the sirup. The bottles move through these two machines in a continuous line.

After the filling operation is completed, the "filling-head" delivers the bottles to a third single-chain conveyor. This carries the bottles a short distance to the crowner, where the caps are crimped on. The bottles move continuously through this machine and are delivered to a collecting table.

Handling System for Test-Tank

The bottles are taken from this collecting table and placed by hand in wire baskets. These baskets are in turn placed on a slat conveyor about 6 ft. wide, which leads through the test-tank. This test-tank is about 15 ft. long, 6 ft. wide and somewhat over 2 ft. deep. The slat conveyor comes in over the top at one end, travels along the bottom of the tank and goes out over the top at the other end. In this way the baskets with their loads of filled bottles are submerged and the operator is enabled to detect and discard any that are imperfect. The speed of this conveyor is about 12 ft. every 10 minutes, so that the bottles are under water over 11 minutes.

As the baskets emerge from the tank, the bottles are removed by hand and placed on a single-chain conveyor. This conveyor is exactly similar to that described above and takes the bottles, erect and in single file, to the labeling machine.

This single-chain conveyor delivers its load directly

CONVEYOR FROM LABELING MACHINES TO NAILING MACHINES

to the labeling machine. Here the desired labels are affixed and the bottles delivered to still another single-chain conveyor.

By referring to Fig. 2 it will be noticed that there is a point—just beyond the labeling machine—where the single-chain conveyor widens into a collecting space. At this point are stationed workers, who take the bottles and place them in the cases waiting on the adjoining roller conveyor. The roller conveyor is horizontal at this point, so that the cases collect and wait until needed. When a case is filled the worker, by a slight shove, sends it on down the conveyor, which has a slope beyond this point.

Near the left or west end of each run of gravity conveyor shown in Fig. 2 a nailing machine will be noticed. As the cases come down the gravity to this machine, the nailing machine operator places the cover and, with his machine, nails it down. At the same time the machine stamps the company's index number and date on this cover.

To Storage or Shipment

Past the nailing machine, the conveyor delivers the cases to a roller spiral conveyor, which takes them at a uniform and easy pace to the first floor. Here they come onto another gravity roller conveyor. This conveyor, shown at the left or west end of Fig. 1, moves them past the storage spaces, where they may be stored in tiers by means of a portable length of gravity conveyor and a stacking machine; or they may be carried on out to the shipping platform, where a portable gravity conveyor takes them directly into the box cars. This main gravity conveyor is also utilized when cases are to be taken from filled-case storage to shipping platform.

Some Features of the Conveyors

The single-chain conveyors described above are a part of regular bottling equipment and are supplied by the makers of this equipment, as are such items as the conveying element of the soaker. The testing tanks and conveyors were especially designed and constructed for the Beech-Nut Co. The remainder of the conveying equipment, comprising gravity roller conveyors, roller spirals, 30-deg. and 45-deg. incline package elevators, is Alvey-Ferguson standard equipment supplied by the Alvey-Ferguson Co. of Cincinnati, Ohio.

A study of the three sketches accompanying this paper in conjunction with the text makes it evident that this system is approximately continuous. It is also automatic with the exception of the following processes: Unloading box cars, loading box cars, loading soakers, loading and unloading test-tank, and placing filled bottles in cases. The only operations which can hold up production are those included between the soaker and the labeler. In order to guard against any delay at this point, this apparatus is installed in duplicate, each set having a capacity equal to that desired for the plant. The speed at which the bottles can be filled is the governing factor and the conveying, washing, crowning, testing and labeling equipment all has a greater capacity than the filling equipment, so that production can always be kept at a maximum.

Economic Side of the Installation

The Beech-Nut Co.'s plant here described has been in operation for the past 3 years only. Being thus one of the most modern plants of its type in this country, it was originally designed about as it exists at present. For this reason and because the beverage industry as a whole is near the same stage of development, it is impossible to give any figures which can serve as a guide to the economy of the automatic equipment. It seems, however, to be self-evident that the cost of handling the materials involved in a production of about 1,800 cases per day, such as we find at the Beech-Nut Co., would be absolutely prohibitive were manual handling used.

The installation here described is as near ideal for the purpose as any which could be found. The points of interruption in the flow, where hand transfer takes the place of mechanical movement, are as close to a minimum as the present available equipment will permit. Without doubt it will be possible at some future time to eliminate even more of these hand movements; but such improvement depends on new designs and inventions.

One of the economic features of this system worthy of notice is the small amount of power conveyor used —gravity supplying the motive power to the fullest possible extent. This may seem a small item; but the saving in expenditure over some bottling systems which depend on belts or apron conveyors should easily take care of the fixed charges on the conveyors.

The writer wishes to acknowledge the courtesy of the Beech-Nut Packing Co., of Canojoharie, N. Y., in opening its plant for the collection of the data of this article. The illustrations are supplied through the kindness of the Alvey-Ferguson Co., of Cincinnati, Ohio, manufacturer of the conveying equipment mentioned above.

Legal Notes

By Wellington Gustin

Contract for Use of Invention Valid Pending Application for Patent

An interesting point on an inventor's rights in his invention pending his application for patent is involved in the recent action brought by the Cook Pottery Co. vs. J. H. Parker & Son to recover royalties evidenced by promissory notes.

It appears that William Morrill Parker, one of the defendants, in January, 1915, filed application for letters patent in the U. S. Patent Office for the device known as the "Nailit knob" and thereafter it was controlled by the defendants; that in May, 1915, the plaintiff, learning of this device, entered into negotiations with defendants and procured a contract dated Oct. 8, 1915, for the use of this device in the manufacture of the "Wedge knob," then being manufactured by the plaintiff, on a royalty basis; that defendants further learned, after said contract had been made, that one A. H. Fargo had also applied for letters patent on a device similar to that of the "Nailit knob," and, in order to protect the plaintiff in the license granted it by defendants, acquired by writing under seal from Fargo, sole and exclusive license to use said invention, said sale and exclusive license being taken by J. H. Parker & Son, Inc., but that defendants J. H. Parker & Son should have the benefit of the same in order to

protect the plaintiff in the license granted to it by contract in October, 1915. It further appears that afterward, Feb. 3, 1920, letters patent for said invention were duly issued to an assignee of Fargo, who afterwards, on April 28, 1920, granted to J. H. Parker & Son, Inc., the exclusive right and license to make, use and sell devices embodying the invention, throughout the United States and its territories for the full life of the patent, and that defendants, by virtue thereof, and by the application by W. M. Parker for letters patent, have always controlled the right to manufacture and sell the "Nailit knob," a name used to designate any two-piece knob for electrical work assembled with a nail and fastened together by means of a washer or swedge or other projection on the lower part of the knob.

Plaintiff's Contention

Plaintiff contended that these facts showed that defendants, J. H. Parker & Son, did not have ownership and control of the "Nailit knob" device and that therefore they had no right to make the use of the "Nailit knob" device the basis or consideration of the contract of October, 1915, and that this contract was therefore without consideration, and void; in other words, that pending an application for letters patent, the applicant has no such ownership or control of the device sought to be patented as would give him the right to license or permit another to use it. It was claimed that plaintiff, or any other, already had full power and right to use this device in the manufacture of its "Wedge knob," pending defendants' application for patent thereon, and that, when it signed this contract, although under seal, there was no basis for its so doing—no consideration therefor. But on this point the Supreme Court of Appeals of West Virginia in this case at bar, 109 S. E. 744, laid down the principle that an inventor has an inchoate right of property in an invention pending his application for patent, with which he may deal as an article of property, citing Richardson versus Essex Machine Co., 207 Mass. 219. The court further says a license to use a device for which application for letters patent is pending may be given and if acted upon and the device used by the licensee in the manufacture of articles in which the invention is used, it will avail to protect the licensee in the use thereof after the invention is patented.

Question of Consideration

Now the doctrine is laid down by the United States Supreme Court that pending an application for a patent the applicant has no exclusive right to its use (Marsh vs. Nichols, 9 Sup. Ct. 168), and while this may be true, says the West Virginia Supreme Court, yet the use by another of the device sought to be patented, pending the application, ceases when the patent has been granted. It was pointed out that the inducement and consideration to the Cook Pottery Co. for the contract of October, 1915, was to obtain the right to use this device not only pending the application, but to be protected in its use after the device had been invented. The contract was given under seal and a sealed instrument implies a consideration has been passed.

Other observations in the suit were that where defendants were about to pass through bankruptcy when creditors would receive nothing, the saving of plaintiff's claim from the bankruptcy proceedings was a sufficient consideration for the continuance of an agreement between the parties; and again, when a contract under which one-half of commissions to be paid by plaintiffs should be applied on debts owing from the defendant contained no definite agreement as to its termination, it was not invalid for such reason, a reasonable time being contemplated as a matter of law, and what would be a reasonable time was for the court and jury to decide under the circumstances.

Reasonable Time for Delivery of Goods Imported With No Time Limit Set

A problem of purchase and sale of goods to be imported is presented in the recent action of Garbiss Dilsizian et al. against A. Klipstein & Co. to recover damages for breach of contract because the company refused to accept a tender of shipment of 50 tons of gum arabic.

Terms of Contract

The contract was dated April 23, 1918, and provided for the sale of 50 tons of 1918 crop, freight average at 25c. per lb. net, c.i.f. New York. Shipment was "From Red Sea to New York on vessel Phyllis, which is now on her way to Red Sea" and there was a provision that "Sellers not responsible if shipment of merchandise or sailing of vessel prevented by any government regulations in country of export or destination, by act of God, perils of the sea, or by any other circumstances beyond the seller's control."

On trial the defense was that there had been an unreasonable length of time consumed before delivery, giving the buyers the right to refuse to receive the goods.

Delay Not Unreasonable, as No Delivery Date Was Specified

The Phyllis was a sailing vessel. She began loading in September, 1918, taking on 10,000 bags of gum arabic. Her cargo was loaded at Massowah. It came from vessels arriving from the Sudan, transferred to her, after which she was towed 400 miles to Aden, where she arrived in November, 1918. A mail-carrying vessel could not have reached the port of New York until December 31, 1918. The Phyllis landed in New York on May 29, 1919. She was a slow boat and her speed was not apparently in the minds of the parties at the time they made the contract. From these facts and circumstances the court found that there was no unreasonable delay in making delivery of the gum arabic as required by the terms of the contract. The contract was in the course of performance. The ship was making her course to New York and in the absence of express terms as to time of delivery she had a reasonable time under all the circumstances to make the voyage. When the time is fixed, failure to make delivery justifies a refusal to be bound by the contract. Punctuality as to delivery was disregarded by the parties in the agreement.

An attempt to rescind the contract or refuse to be bound thereby, without warning or demand for the goods from the day of loading until their arrival in New York, indicated a desire to find a convenient excuse for avoiding the consequences of the contract. A drop in the market price of gum arabic in the meantime to 13c. per lb. may have been the reason therefor, says the court.

Damages for the difference between the contract price and the market price were demanded, together with storage, all totaling $12,965. The trial court found for the sellers and this judgment was affirmed by the United States Circuit Court of Appeals, 273 Federal R. 473.

The Technology of the Carbon-Electrode Industry—III

A Critical Review of the Calcination Process: Why It Is Necessary and What It Accomplishes—Details in the Design and Operation of Electric and Gas-Fired Calciners, With Special Reference to Their Use in American Practice—Recent Developments*

BY CHARLES L. MANTELL
Division of Industrial Chemical Engineering, Pratt Institute, Brooklyn

PRECEDING articles in this series have dealt with the history of the development of the carbon-electrode industry and have discussed the raw materials entering into the manufacturing processes. It is the intention in the present installment to take up the first step in production—to discuss critically the calcination process and the equipment used therein. As preliminary to that discussion, it is perhaps desirable to direct attention to a number of terms more or less intimately connected with the carbon industry. First, let us consider the process of calcining itself. It is sometimes defined as "the heating of a substance to a white heat." This probably is in keeping with the original derivation from the Latin *calcinare*, meaning "to burn like lime." In the more restricted sense in which the carbon-electrode industry uses the term, however, calcination refers to the heating of a carbonaceous substance to the temperature required to yield a material with a content of volatile matter not exceeding 0.5 per cent. Uncalcined materials are generally referred to in the industry as "green," implying that further fabrication is required.

There may be said to be four reasons why calcination of carbonaceous substances is necessary in electrode manufacture: (1) The green materials when ground cannot readily be bound together into an electrode of proper density. (2) They are difficult to mold or extrude. (3) They give off their volatile matter during baking, thus resulting in a very porous electrode. (4) They are poor conductors and have a much higher resistivity than the calcined material. Calcination causes an actual shrinkage in the volume of the carbonaceous substance. It therefore effects an increase in the specific gravity or real density of the electrode as it is often termed in the industry.

Calcining Equipment and Its Operation

The calciners used in the electrode industry are either developments of the industry and its close connection with electrothermic and electrolytic processes, or else are adaptations from the manufacture of gas for industrial or illuminating purposes. The electric calciners, or "shrinkers," as they are often called, are example of the first class, and the Woodall-Duckam and Glover-West vertical gas retorts are examples of the second.

Of the two types of equipment used in the calcining process—the electric and gas—the latter are by far the more prevalent. The electric calciners, however, were the first to be used in the industry, and where electric power is cheap and abundant they possess certain desirable features. Each of the various types of calcining equipment is now to be discussed, with particular reference to those in American practice.

INTERMITTENT ELECTRIC CALCINERS

Intermittent electric calciners usually consist simply of upright cylindrical steel shells lined with a highly refractive firebrick and resting on a ring of refractory brick work. A diagrammatic sectional elevation is shown in Fig. 2. Single-phase alternating current, with a voltage range of 30 to 60, is supplied to the aluminum or copper busbars encircling the shell.[15] Riser buses

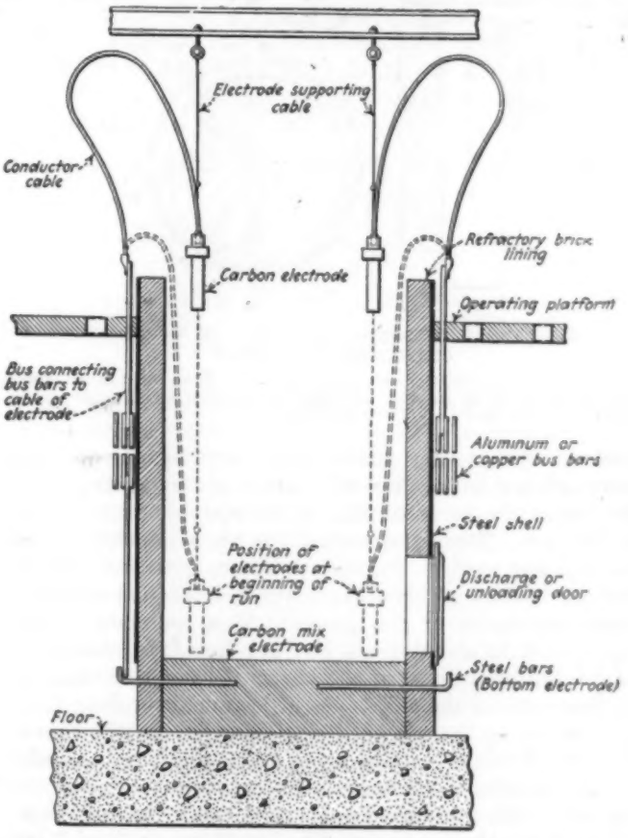


FIG. 2—SECTIONAL ELEVATION OF INTERMITTENT TYPE OF ELECTRIC CALCINER

from the upper ring of busbars serve to carry the current to the flexible conductor cables connected to the electrodes. The electrodes, usually 6 to 8 in. in diameter and 42 to 60 in. long, are suspended from above by the use of steel wire cables. Strain insulators serve to insulate the cast-iron head of the electrodes from the cable and the overhead supporting beams. These elec-

*Part I, which reviewed the history of the industry, appeared in *Chem. & Met. Eng.*, vol. 27, No. 3, July 19, 1922. Part II, dealing with the raw materials for electrode manufacture, appeared in *Chem. & Met. Eng.*, vol. 27, No. 4, July 26, 1922.

[15]For further electrical details than are given in this article, see Yardley, "Production of Shrunk Coke in Electrode Manufacture," *Chem. & Met. Eng.*, Feb. 15, 1922, vol. 26, p. 321.

trodes are protected from rapid oxidation by sheet-iron casings filled with a tar-bound mix of finely ground carbon. The construction is shown in Fig. 3.

The lower ring of busbars supply current to the bottom electrodes through risers which consist of rolled steel bars, bolted on the outside of the shell to the riser buses. The bars, usually 2 in. thick and 8 in. wide, are imbedded in a baked layer of a tar-bound carbon mix, which has been placed in the bottom of the shell while in a plastic condition and baked in place.

The arrangements and spacing of the suspended electrodes and the corresponding spacing of the bottom ones are as shown in Fig. 3.

In operating the calciner the top electrodes are

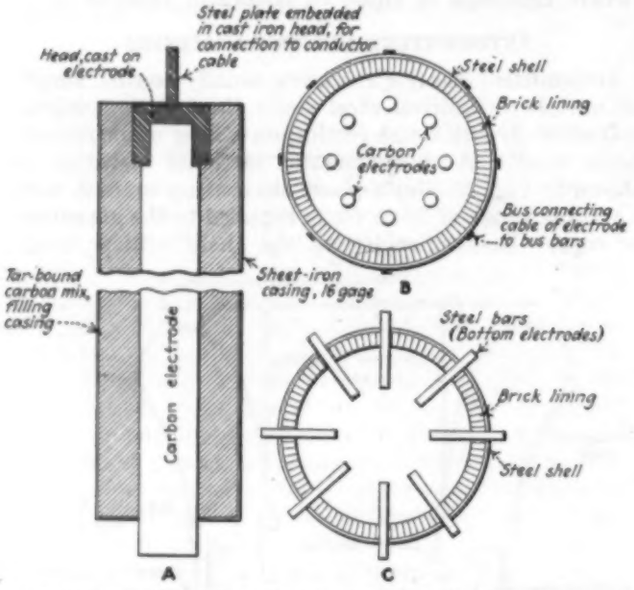


FIG. 3—CONSTRUCTIONAL DETAILS OF INTERMITTENT ELECTRIC CALCINER

A—Sectional elevation of electrode. *B*—Plan of top showing arrangement of electrodes. *C*—Plan of bottom showing arrangement of steel bars in bottom electrode.

lowered so that they almost touch the bottom and thus cause an arc to be formed. Green material, fed in at the top of the furnace, falls to the bottom and is heated by the arc. When the material is heated sufficiently to conduct the current, the electrodes are gradually raised, the arc broken and heating continued through the electrical resistance of the charge. More and more material is fed in at intervals and the electrodes raised as each additional layer of the charge becomes conductive. In this manner the electrodes are gradually raised from the bottom to the top of the calciner during the course of 8 to 12 hours. Heating is then continued, usually for an additional 12 hours. After about 24 hours the top electrodes are raised out of the bed of heated material and the charge is permitted to stand or "soak" for 24 hours before it is unloaded. This is done so that the charge will develop the same heat in all portions of the material, and time will be allowed for the volatile matter to escape through the charge. Furthermore, it is necessary for the whole mass to cool somewhat before unloading. It has been found that the percentage of volatile matter of the calcined coke varies inversely with the "soaking" time; the longer the soaking time the lower the volatile matter.

The charge is unloaded from the calciner by opening the discharge door on the side, breaking down the brick work, and hauling out the coke with long-handled rakes. As the material is still red hot, it is usually cooled by spreading it out on the floor in thin layers, or when necessary, sprinkling it with a fine spray of water. Wetting must be very carefully done, however, in order to avoid an excess that will not be evaporated by the coke. Moisture specifications for calcined coke call for a maximum of 0.3 per cent of water in order that when the material is finely ground it will not clog or "plug" the grinding mills.

The Trend of Recent Developments

The development of electric calcining units, particularly during the last 10 years, might well be shown by a brief review of the patents on the subject during that period. The developments have been along the lines of continuous furnaces, with attention given to the preheating of charges and recovery of the sensible heat of the calcined material as well as to the recovery of the valuable combustible gases produced as a result of calcination.

Attempts have been made at various times to convert the intermittent vertical type of furnace into a continuous one by providing it with some means of removing the calcined coke as it has been calcined. In most of these experiments there was little, if any, cooling of the coke and no sensible heat recovery; furthermore, the gas produced in the process was lost. These studies have resulted in only slight improvements over the original intermittent type of calciner.

Brown[16] is responsible for the adaptation of the hollow electrode to electric calciners. One of his earlier furnaces is shown diagrammatically in Fig. 4. It consists essentially of a hollow electrode located at

[16]John W. Brown, U. S. Pat. 1,067,795 (July 22, 1913).

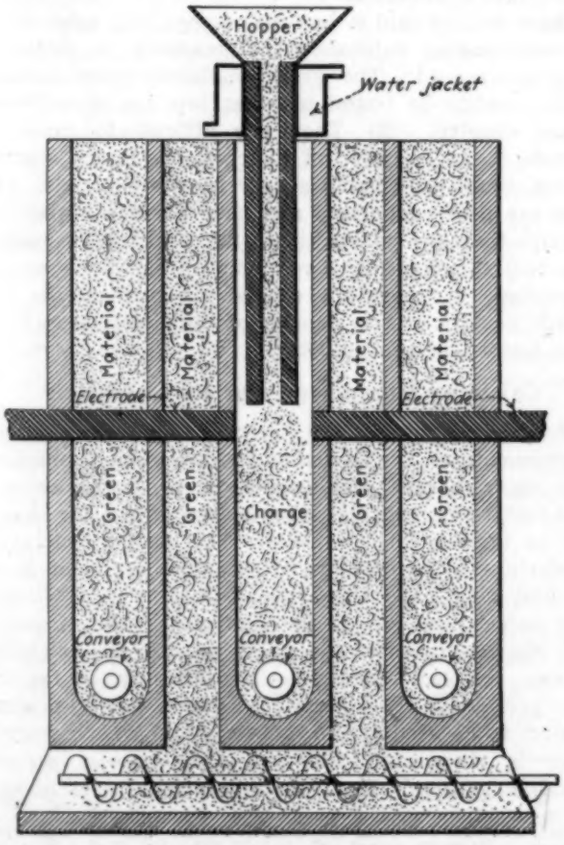


FIG. 4—HOLLOW ELECTRODE CALCINER (EARLY DESIGN)

the top of the furnace and passing through the cover, through which the material to be calcined is fed. There are two solid electrodes set horizontally through the side walls of the furnace. The radiated heat of the charge undergoing calcination is made use of by causing green material to pass on the outside of the material part between the inner and outer shells of the furnace before being placed in the heating zone. The method will be easily understood by referring to the figure. Some sort of conveying machinery serves to remove the heated coke from the various chambers.

Brown next expanded the idea of using a high temperature and exposing the material to this temperature for only a short time by making the passage through the furnace very rapid. Fig. 5 shows an extension of his method of heat recovery by the use of surrounding layers of uncalcined material passing in the same direction as the charge.

In 1915 Brown[17] patented an electric calciner which

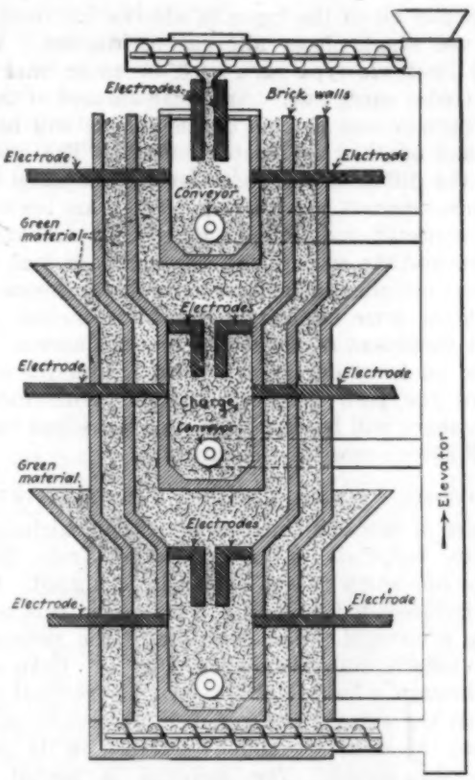


FIG. 5—COMBINATION OF HOLLOW ELECTRODE CALCINERS TO UTILIZE HIGH TEMPERATURE AND SHORTER TIME OF EXPOSURE

was continuous in its operation and recovered the gaseous products of calcination by a suction system. This is shown in Fig. 6. The charge enters the furnace from the hoppers at the top, dropping down through the opening between the upper electrodes. It is calcined during its passage between the upper and lower electrodes. The lower electrodes are hollow and serve as a means of entrance for blowing in gases drawn off at other portions of the furnace. These gases cool the electrodes and in their upward passage after being heated in the heating zone serve to preheat the cool uncalcined coke. The walls inclosing the charge are of carbon, and are insulated from the outer retaining walls by some good non-conductor. The gases resulting from calcination are drawn upward and are cooled in the the condensing chambers C_1, C_2, C_3, C_4, C_5, from which they are drawn through pipes to the exhaust fan. The calcined coke is removed at the bottom of the chamber by a conveying apparatus.

Later a furnace[18] was brought forward which was continuous in operation, recovered the gases resulting from calcination and used these gases to reclaim heat

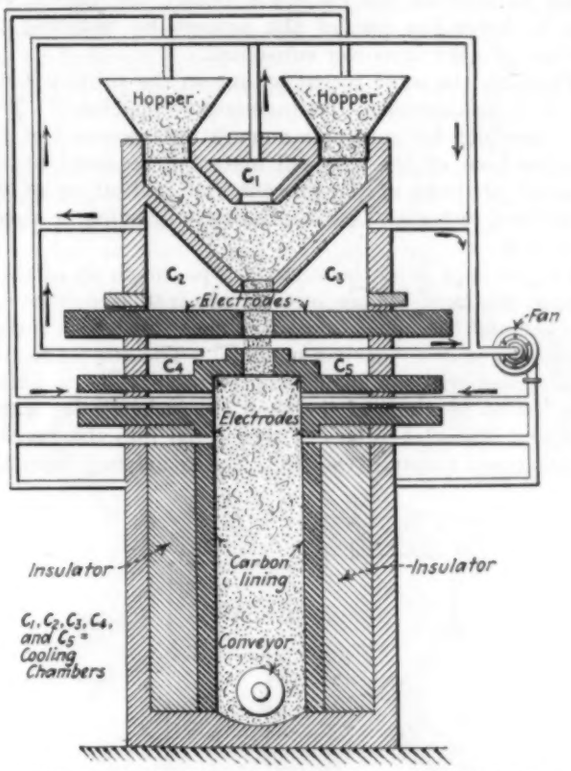


FIG. 6—AN EARLY DESIGN OF A CONTINUOUS CALCINER

from the calcined coke and preheat the green charge. A diagrammatic sketch of the furnace is shown in Fig. 7. Essentially the unit consists of a brick shell in which there is an upper and lower electrode. The charge enters through an opening at the top and passes by the upper electrode into an inverted conical shaped chamber which is carbon lined, then into a restricted cylindrically shaped chamber, also carbon lined, where most of the calcining takes place. Dropping from here into another carbon-lined chamber shaped like the frustum of a cone, the charge finally passes to a conveyor mechanism which removes the material from the furnace. Calcining takes place as current is introduced into the furnace through the upper electrode. Some of the current will pass through the adjacent charge and some through the chamber lining to the cylindrically shaped portion of the furnace, where, due to the negative coefficient of temperature resistance of the carbonaceous charge and the construction of the side wall lining, most of the current passes through the charge. The side wall lining is built of carbon blocks with surfaces corrugated where they come in contact; as a result their contact resistances are very high (see Fig. 7). From then on most of the current passes to the side walls and to the lower electrode and only a small portion through the charge to the electrode. The calcined material is cooled

[17]U. S. Pat. 1,143,940.

[18]U. S. Pat. 1,147,703.

by coming in contact with gases blown in through the bottom of the furnace. The gases in their upward passage cool the heated material, but are themselves heated at the heating zone. The heat they absorb at this point is transferred to the cold green material through which the gases rise, thus preheating it.

At various times patents[19] have been granted for furnaces in which portions of the charge were burned in order to preheat the materials before calcination and also to lower the cost of the process by reducing the amount of electric power consumed.

Probably the most recent patent on the subject is one for a ring-electrode, continuous-type calciner.[20] This type provides for continuous operation, recovery of the sensible heat of the calcined material, recovery of the gaseous products of the process and preheating of the uncalcined material. A diagrammatic drawing is shown in Fig. 8.

The furnace is of the vertical type, made up of three flanged sections. These sections are insulated from one another and the upper and lower ones lined with carbon electrodes or other carbon material. The middle section is provided with an insulating refractory brick lining. The heated portions of the shell are jacketed for water cooling. Material to be calcined is fed into the furnace continuously through the top. Gases arising from the

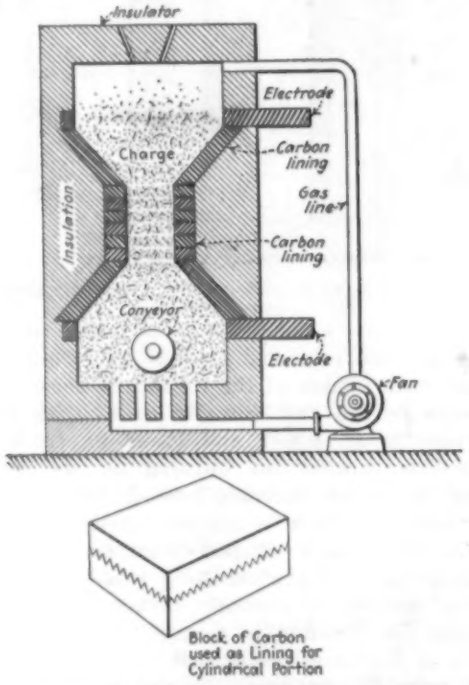


FIG. 7—ANOTHER EXPERIMENTAL DEVELOPMENT OF ELECTRIC CALCINER

expulsion of volatile matter pass off through an offtake at the top. A tee in the pipe allows some of the gases to be returned to the furnace at the bottom after the gases have been scrubbed, cleaned and cooled. The cold gases in passing up through the calciner cool the descending coke, pass through the heating zone between the upper and lower electrodes and cause a more even distribution of the heat. In passing off at the top, since the gases are now very hot, they heat the descending cold green materials and cause them to become conductive by the time they reach the zone of electric heating. Coke is extracted mechanically at the bottom.

[19]U. S. Pats. 1,177,680 and 1,184,817.
[20]U. S. Pats. 1,366,457 and 1,366,458.

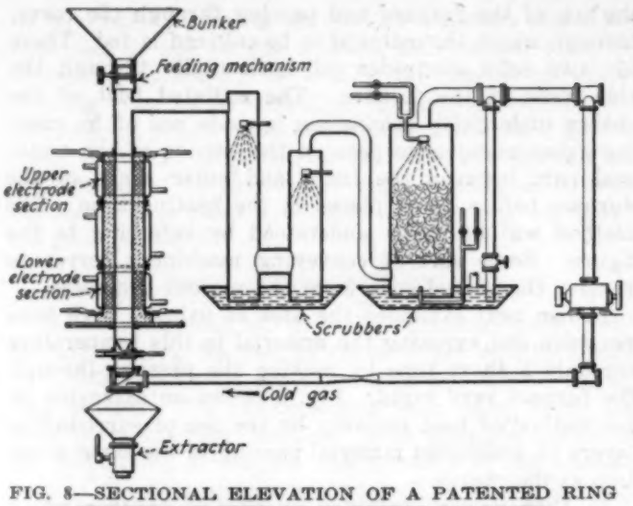


FIG. 8—SECTIONAL ELEVATION OF A PATENTED RING ELECTRODE TYPE OF ELECTRIC CALCINER

Practically all of the types of electric calciners mentioned use single-phase alternating current. In the movable electrode type care must be taken that all of the electrodes carry nearly the same amount of the current, otherwise one portion of the charge will be overheated and another not heated enough. The electrical load on the different electrodes is kept the same by the use of small control board lights. These are low-voltage lamps connected individually to current transformers placed around the riser buses. Evenness of load on the different electrodes is indicated by all the lamps glowing with the same intensity. Due to the negative temperature coefficient of resistance of carbonaceous materials, the tendency during calcination is for the current to follow the path first established. With increased heating, there will be decreased resistance and one portion will absorb most of the current.

Woodall-Duckam Vertical Retort System

The use of Woodall-Duckam retort for calcining carbonaceous materials is an adaptation from the gas industry for which it was originally designed. It was first introduced in England in 1903 and in this country not long afterward. The principle of the system may be more readily understood from Fig. 9.[21] Coke or coal is fed through a hopper at the top of a vertical retort, heated on the sides. The speed of descent is so regulated that the coke is gradually calcined in its passage through the retort. The material is heated as it descends, and the gases from the volatile matter are evolved as the material reaches the proper temperature zones. The gases ascend, and are taken from the top of the retort. Thus the process is really one of fractional distillation.

The amount of material fed to the retort and the rate at which the charge descends are automatically governed by the rate the coke is removed from the bottom of the retort.

The retorts are rectangular and tapered from the top to the bottom. The retorts walls are formed of tongue-and-groove bricks, paneled out at the back so that the heat is readily conducted to the charge. The heating flues are vertical, the division walls of the bricks being bonded into the walls of the retorts and also into the back walls of the flues.

The gas from the producer (either built in or an out-

[21]The author is indebted to J. S. DeHart, Jr., of the Isbell Porter Co., of Newark, for the use of cuts illustrating the Woodall-Duckam system.

side one) or else calciner gas from the operation of the retort, and the secondary air from the recuperator are admitted at the top of the vertical flues and burn downward. The secondary air passes around the lower end of the retort before it enters the recuperator. As now built, this recuperator is of box construction for the waste gas with the air baffling on the outside. The temperature of the secondary air is raised almost to that of the waste gases. Dampers are provided at the bottom of the retorts so that the pull can be regulated to both sides of each retort. Main dampers are provided on the waste gas outlet of the recuperator. Regulating dampers are provided on the gas and secondary air flues to each pair of retorts.

In shrinking petroleum coke in these retorts, temperatures of 1,050 to 1,250 deg. C. are maintained, resulting in waste gases in the recuperators with temperatures of 650 to 850 deg. C.

In the Woodall-Duckam extractor the coke is cooled by the water jacket before it is discharged. Fig. 10 shows the sectional elevation of a typical plant for the calcination of petroleum coke such as is built by the Isbell-Porter Co. of Newark, N. J., which holds the Woodall-Duckam rights in this country. The plants are built either with or without an internal gas producer. When petroleum coke is used much lighter gas is given off than with coal so that the brick-lined gas main may be substituted for the more complicated hydraulic main generally used in the calcination of coal.

The temperature of the combustion chambers is highest at the top where the heat is most readily absorbed by the cold material, and lowest at the bottom where the charge is completely calcined.

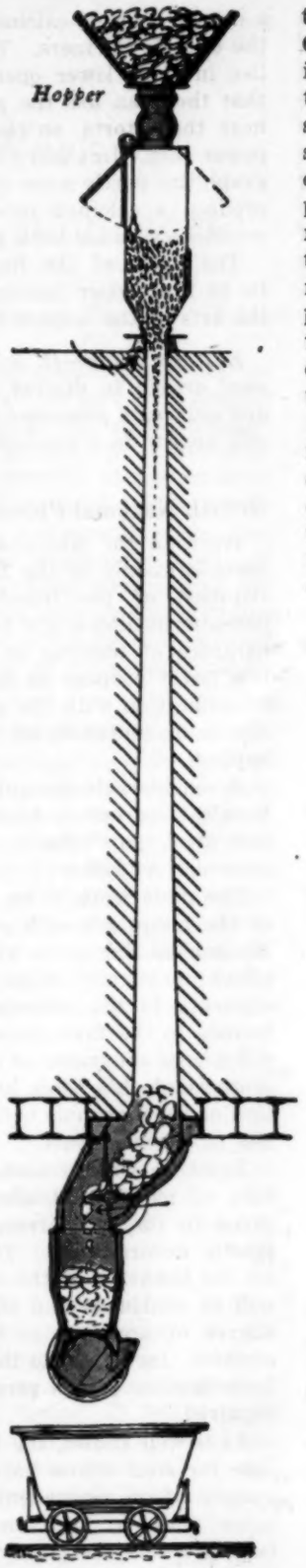


FIG. 9—SCHEME OF WOODALL-DUCKAM SYSTEM

Glover-West Vertical Retort System

The Glover-West system of vertical retorts was based on patents granted in 1905 to Young and Glover. In basic constructional details these retorts resemble those used on Scottish oil shales. In 1909 the present Glover-West system was introduced into England. As in the Woodall-Duckam system the calcination is continuous, but the methods of arranging for this vary in some detail. In the first place, the retorts are oval in section, instead of rectangular, and are built up of concentric fireclay rings. The bottom 3 ft. of each is composed of cast iron or special silica blocks and forms a regeneration chamber for the secondary air entering the producer. The passage of the gas from the retorts may be followed by means of Fig. 11. An outlet is provided at the base of each coal-feeding hopper, whence the gas is conducted by a 7-in. pipe to a dry main. Each outlet pipe is fitted with a valve which is brought into use when a retort is out of action for scurfing purposes.

The coke extraction is continuous and governs the rate at which coal is delivered. The extractor consists of a slowly revolving vertical worm, driven at a speed of one revolution in about 35 to 40 minutes. The extractor is built in two halves so that one half may be removed and the retort readily inspected. The speed of the extractors is adjustable. Dropping from the

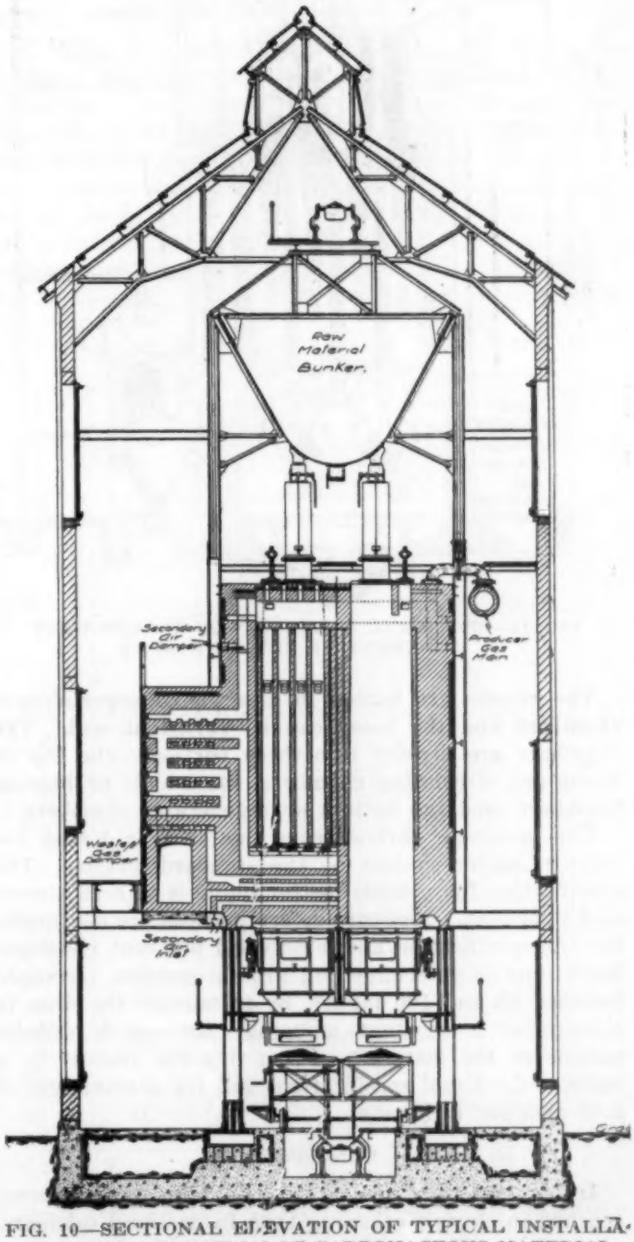


FIG. 10—SECTIONAL ELEVATION OF TYPICAL INSTALLATION FOR REDUCTION OF CARBONACEOUS MATERIAL

extractor, the coke passes into a chamber fitted with a self-sealing lid and is removed from this at intervals of about 2 hours. The system of heating the retorts differs from that of the Woodall-Duckam in that combustion takes place toward the bottom of the retorts and the waste gases pass around the upper portions into the horizontal circulating chambers before finding their way to the chimney. On account of the cooling action of the secondary air passing around the base of the retort, no water quenching is needed and the coke is discharged from the lower chambers practically cold.

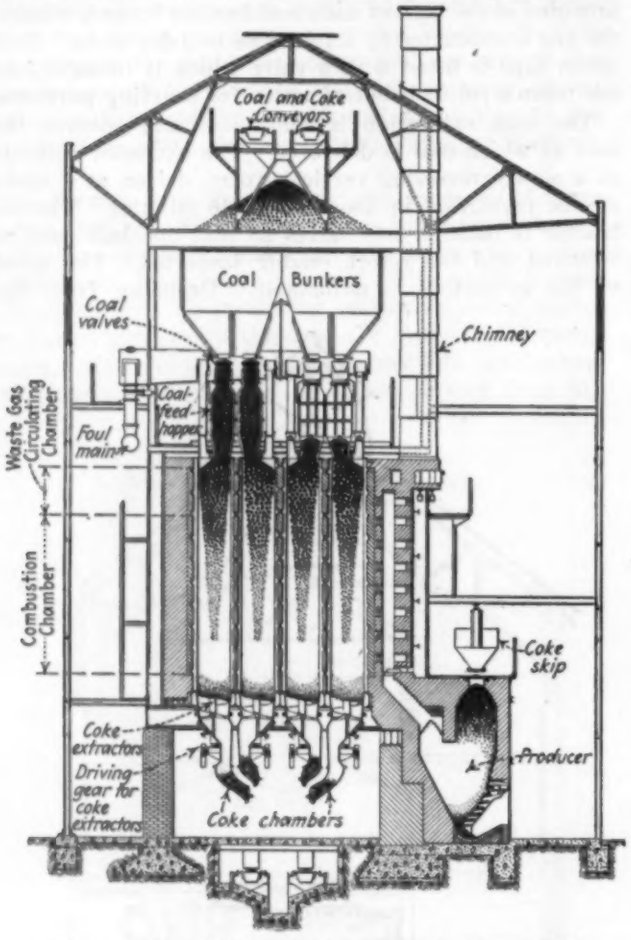


FIG. 11—SECTIONAL ELEVATION OF GLOVER-WEST VERTICAL RETORT SYSTEM

The retorts are heated in a series of superimposed chambers and the heats can be varied at will. The chambers are divided into three portions—the top or waste gas circulating chambers, the middle or heating chambers, and the bottom or regenerator chambers.

The calcined carbonaceous material is tested for volatile matter content by the standard method. The specification for volatile matter limits it to a maximum of 0.5 per cent. Moisture determinations are also made, for the specification allows only 0.3 per cent moisture. Resistivity is determined on ground samples (screened between 35 and 100 mesh), by measuring the drop in voltage at a constant amperage through a definite volume of the material. From this the resistivity is calculated. Usual specifications call for a maximum of 0.05 ohm per inch cube.

Conclusion

In general, due mostly to the high temperatures reached in electric calcining than in gas-fired calciners, a denser coke or calcined product will be produced in the electric calciners. The advantage of gas-fired units lies in their lower operating costs, aided by the fact that they can use the gases driven off in calcining to heat the retorts, so that there will be practically no power cost. In electric calciners there is a tendency to graphitize partly some of the charge and in this manner produce a calcined product of lower resistivity than would be possible with gas retorts.

The basis of the finished electrode may be said to lie in the proper calcination of materials. Without it the arts of the expert carbon maker are of no avail.

Editor's Note—It is the author's intention in the next article to discuss the grinding, mixing, molding and extrusion processes in the electrode industry. This will appear in a subsequent issue.

British National Physical Laboratory Report, 1921*

Work in the laboratory on iron and steel has been devoted mainly to the further investigtion of the constitution of the iron-nickel-carbon alloys, the iron-phosphorus alloys, and to the determination of the temperature of melting in the iron-carbon system. For this latter purpose an electrical method, first developed in connection with the study of the constitution of the aluminum-copper-nickel system, is being successfully applied.

A considerable amount of investigatory test work has been carried out in relation to cases of failure in iron and steel, particularly, the cracking of boiler plates around rivet holes.

The main work to be undertaken under the auspices of the alloys research committee of the Institution of Mechanical Engineers will relate to the study of ferrous alloys, primarily binary alloys of iron with other elements in the absence of carbon. This work will include in the first place the determination of the constitutional diagrams of some of the more interesting systems of this kind, and where possible the correlation of the diagrams obtained with the physical properties of the materials.

Research will be continued upon the physical structure of metals and alloys, particular attention being given to the measurement of the heat generated by plastic deformation. The experiments already made on the behavior of the more plastic metals in tension will be continued and efforts made to obtain a higher degree of accuracy in the determination of the heat evolved. Incidental to the above researches, the further investigation of the properties of amorphous metal is required.

As is well known, the Brinell hardness test is unsuitable for steel whose hardness number exceeds 500, on account of the permanent deformation of the ball which takes place in such cases. Some consideration has been given to the possibility of determining a scale of hardnesses for very hard materials from the amount of permanent flattening of the ball, and an instrument has been constructed in the workshops by means of which this flattening can be measured. Given careful manipulation of the instrument and a trained observer, and provided that a supply of steel balls of uniform hardness can be obtained, it is believed that the method will be a valuable one in discriminating between the hardness numbers of very hard steels.

*Abstracted in *The Iron and Coal Trades Review*, June 30, 1922.

Boiler Plate After Cold-Work or Work at Blue-Heat

High Proportional Limit Exists While Tempering Cold-Rolled Plate at 300 Deg. C., or After Cooling to Room Temperature—Elastic Limit Can Be Made to Approximate Ultimate Strength by Overstraining Successively at Blue Heat With Gradually Increasing Loads

By H. J. French, Physicist, Division of Metallurgy, Bureau of Standards

COLD-WORK increases the elastic properties[1] of steel at ordinary temperatures and to a smaller degree the tensile strength, with an accompanying decrease in ductility. The greater the total reduction by cold-work within the capacity of the material the greater is the increase in strength. The tensile properties of steel at elevated temperatures are likewise modified. Jeffries[2] reports increased strength at blue-heat (200 to 300 deg. C.) after Armco iron has been drawn at room temperature with moderate reductions, but with 96 per cent reduction by cold-drawing the tensile strength is greater at room temperature than at any higher one.

Cold-Rolled Boiler Plate

The tensile properties at various temperatures of cold-rolled firebox and marine grades of boiler plate as determined by the author[3] are shown in Fig. 1. Comparison with curves 1 and 2 of Fig. 2, reprinted from the previous article, indicates that ⅛ in. cold-reduction, approximating 12.5 per cent of the original plate thickness, increases the tensile strength at room temperature about 20 per cent, a margin which is maintained up to about 465 deg. C. (870 deg. F.), showing that this cold-working effect is maintained until relatively high temperatures are reached.

The changes in proportional limit are more marked and of considerable interest. At ordinary temperatures there is an increase of 80 to 95 per cent. Similarly an increase of 60 to 100 per cent above the values obtained in tests of hot-rolled plates is found at temperatures up to and including 245 deg. C. (470 deg. F.). In the blue-heat range [295 deg. C. (565 deg. F.)] the increase in proportional limit due to cold-work reaches the very high value of 150 per cent in the marine plate and nearly 200 per cent in the firebox grade. This, however, is not accomplished at the expense of ductility, as the elongation, which was reduced by one-half at room temperature, equals that of hot-rolled marine plate when tested at 295 deg. C. The relation between reduction of area of cold- and hot-finished marine steel has likewise increased to some extent, while that for the firebox grade has decreased but slightly.

Effect of Tempering Cold-Rolled Plate

In order to determine whether these changes at blue-heat are maintained at ordinary temperatures specimens were tempered at successively increasing temperatures and then tested at room temperature. The results, which are represented in Fig. 3, illustrate, in so far as the tensile properties are concerned, the benefits derived from "bluing" cold-finished products such as thin-wall seamless steel tubes. A short tempering in the blue-heat range, 295 deg. C. (565 deg. F.), materially increases the elastic ratio with little effect on the other tensile properties. This firebox steel had its limit of proportionality increased about 20 per cent. It is likewise apparent that a short tempering at somewhat higher temperature accomplishes little improvement.

Blue-Rolling

Working steel in the ranges where temper-colors are produced has long been considered deleterious and even dangerous. Stromeyer[4] warns against such practice, referring to his series of tensile and bending tests on iron, mild and hard steels, and writes: "It is very common practice amongst boiler-makers to 'take the chill out of the plate' if it requires a little setting, or to set a flanged plate before it is cold. This is really nothing else than working it at a blue-heat and should not be allowed. . . . All hammering or bending of

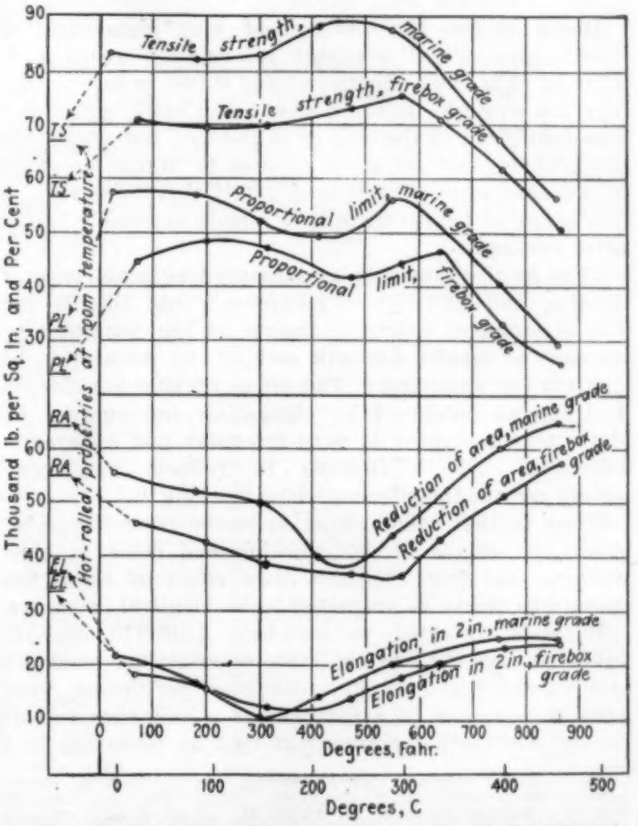


FIG. 1—TENSILE PROPERTIES OF OPEN-HEARTH BOILER PLATE AFTER 12½ PER CENT REDUCTION BY COLD-ROLLING

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[1] Yield point, proportional limit and elastic limit.

[2] "Physical Changes in Iron and Steel Below the Thermal Critical Range," "Mining and Metallurgy," 1920, section 20, p. 158.

[3] "Strength and Elasticity of Boiler Plate at Elevated Temperatures," *Chem. & Met. Eng.*, vol. 26, p. 1207, June 28, 1922.

[4] "The Injurious Effect of a Blue-Heat on Steel and Iron," *Proc.*, Inst. Civil Eng., vol. 34, p. 14 (1886).

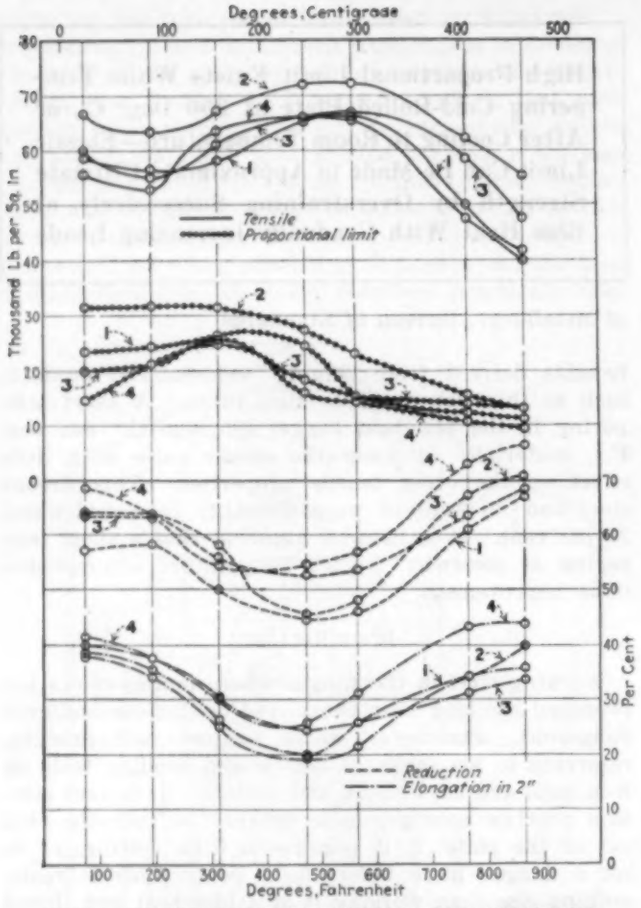


FIG. 2—TENSILE PROPERTIES OF FOUR HEATS OF BOILER PLATE MADE OF OPEN-HEARTH STEEL

iron and steel should be avoided, unless the metals are either cold or red-hot."

Howe in the 1891 edition of his "Metallurgy of Steel" summarized available information relating to what he calls "blue-shortness" and states in part: "Not only are wrought iron and steel much more brittle at a blue-heat[8] than in the cold or at redness, but while they are probably not seriously affected by simple exposure to blueness, even if prolonged, yet if they be worked in this range of temperature they remain extremely brittle after cooling. . . ."

"The loss of ductility as measured by endurance of bending and drifting is enormous; that this is not due to incipient cracks is shown by the simultaneous increase of tensile strength and by the restoration of ductility by annealing. The effect of blue-working on ductility as measured by elongation (on rupture by static tensile stress) is very irregular and apparently anomalous. . . . Heating to redness may completely remove the effects of blue-working."

Howe further called attention to the resemblance between the effects of cold-working and those of blue-working and that the immediate effect of these two operations might be suspected to be identical in nature.

Ridsdale[9] referred to blue-heat [315-370 deg., C. (600-700 deg. F.)] as the state of minimum plasticity and showed that soft steel developed brittleness when worked or soaked in a furnace for a long time in this range. He further pointed out that by reheating to a suitable temperature the good qualities of such steel were restored.

Jeffries[1] has studied the effects of blue-work on the tensile properties of Armco iron and reached the following conclusions:

1. Armco iron deformed at room temperature a given amount does not increase as much in tensile strength as when deformed the same amount at blue-heat.
2. The effect of drawing Armco iron at 200 to 400 deg. C. is to produce greater tensile strength at all temperatures up to 550 deg. C. than would obtain with the same amount of deformation in the cold. The elongation is less after drawing at 200 to 400 deg. C. than after drawing at room temperature. The same conclusion is true, in general, of the reduction of area.

While there seems to be unanimity of opinion that blue-work is deleterious to steel, Howe early called attention to the fact that "millions of car axles, blue from 'hot-boxes,' are chilled with snow and jarred under heavy load at loose rail joints, yet are apparently unharmed. Among the many thousand steel boilers, tens of thousands of plates must have been worked more or less at blueness; yet failures are rare."

More recently it has been questioned whether crankshafts for airplane engines can be safely straightened while cooling from the tempering heat.

Plates Rolled at 300 Deg. C.

In order to determine the effect of permanent deformation at blue-heat on the high-temperature properties of boiler plate several pieces of railway firebox steel[3] (series 4) were reduced at about 300 deg. C. from $\frac{1}{2}$ in. to $\frac{11}{16}$ and $\frac{7}{8}$ in., representing respectively 6.25 and 12.5 per cent reduction. The patterns were rolled in a single stand 16-in. mill, a number of light reductions to effect the totals mentioned above being used. An attempt was made to straighten some of the plates cold and also at blue-heat immediately after rolling, but they broke transversely with a very coarsely crystalline fracture as soon as pressure was applied. Comparison between curves 4 of Fig. 2 and Fig. 4 shows:

1. The increase in strength at room temperature resulting from cold-reduction of 12.5 per cent (Figs. 1 and 2) is about the same as that produced by half this

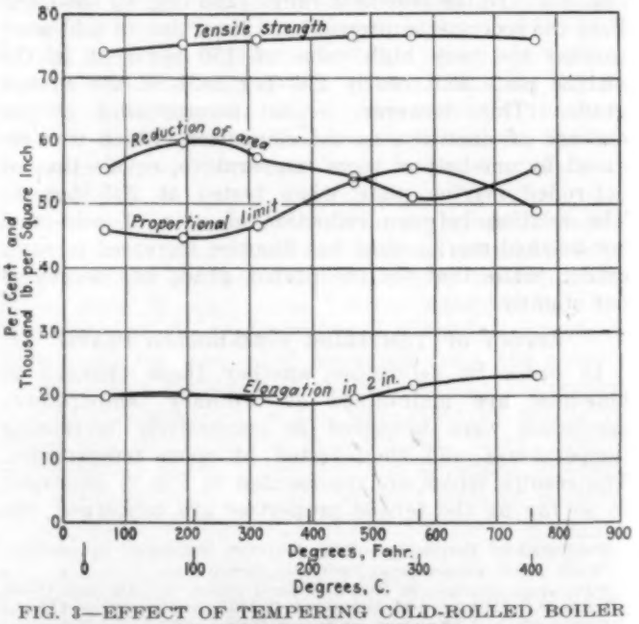


FIG. 3—EFFECT OF TEMPERING COLD-ROLLED BOILER PLATE (FIREBOX GRADE)

[8] The terms blue-work, blue-shortness, etc., as used by Howe, refer to temperatures where ordinarily temper-colors are obtained and may be considered to be within the range 220-320 deg. C. (430-600 deg. F.).

[9] "Correct Treatment of Steel," *J. Iron and Steel Inst.*, 1901, No. 2, p. 52.

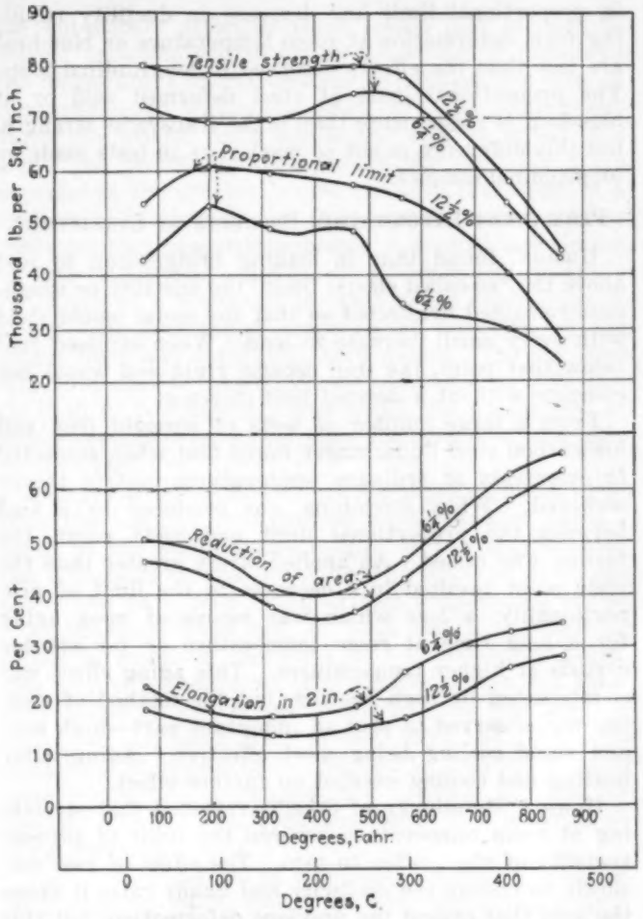


FIG. 4—TENSILE PROPERTIES OF SERIES 4 FIREBOX STEEL AFTER ROLLING AT BLUE-HEAT

reduction (6.25 per cent) at blue-heat (Figs. 2 and 4). This, in general, is also true at temperatures up to 295 deg. C. (565 deg. F.) (blue-heat). Above this temperature the increase in strength resulting from blue-deformation is somewhat less than that from cold-rolling.

2. A "blue-reduction" of twice the amount does not increase the strength at room or elevated temperatures proportionally.

3. At 245 deg. C. (470 deg. F.) the strength of the blue-worked steel is little in excess of that hot-rolled.

4. The maximum tensile strength of the steel subjected to 6.25 per cent blue-reduction is obtained at blue-heat [295 deg. C. (565 deg. F.)] and the shape of the tensile strength versus temperature curve shown in Fig. 4 is similar to that for the cold-rolled steel (Fig. 1). Tensile strength versus temperature curves change direction quite abruptly at or about 295 deg. C. (565 deg. F.).

5. The increase in the limit of proportionality at room temperature resulting from 6.25 per cent blue-reduction is greater than that obtained from twice as much cold-reduction. This is also true up to 245 deg. C. (470 deg. F.), above which the increases are about equal.

6. The form of the proportional limit versus temperature curve for steel reduced 6.25 per cent at blue-heat is similar to that reduced twice this amount in the cold, but the secondary increase (which in the cold-worked steel appears to attain its maximum at about 340 deg. C.) occurs at 245 deg. C. in the blue-worked metal. This inflection is not observed in the steel subjected to 12.5 per cent blue-reduction.

7. Elongation and reduction of area decrease to a minimum in the neighborhood of 200 deg. C. (410 deg. F.) and thereafter increase to high values at 465 deg. C. (870 deg. F.). There appears to be a more rapid increase in elongation between 295 and 410 deg. C. (565 and 770 deg. F.) coincident with the rapid decrease of proportional limit mentioned above for steel reduced 6.25 per cent at blue-heat.

The effect of partial annealing of blue-worked steel is shown in Fig. 5. The proportional limit decreases until an annealing temperature of about 500 deg. C. (930 deg. F.) is reached, but annealing with slow cooling up to about 600 deg. C. (1,110 deg. F.) greatly increases the elastic ratio. Annealing for 30 minutes at about 730 deg. C. (1,345 deg. F.) completely removes the effects of blue-deformation.

Depth of Penetration of Effects of Blue- and Cold-Rolling

Since the effects of blue- and cold-work are so marked and maintained over a considerable temperature range, the question naturally arises as to whether the increased strength of the plate is due to hardening of the "skin," or whether the magnitude of the observed effect is substantially the same throughout the cross-section of such light plates as are under investigation.

The surfaces of cold- and blue-rolled bars were accordingly milled to progressively increasing depths and tested in the usual manner at room temperature, and it was found that there is substantially no difference in the strength when even a considerable depth of surface metal has been removed. Ductility (elongation and reduction of area) gradually decreases with removal of increasing layers of metal, due no doubt to the decrease in thickness of the specimen while the width has been kept constant.[1]

Transverse Strength at Various Temperatures

Tests of longitudinal specimens taken from plates rolled at various temperatures do not fully define the effects of such work, even when considering only the tensile properties. Accordingly tests were made on samples taken transversely from hot-, cold- and blue-rolled firebox steel of series 4. The results are given in Fig. 6.

[1] H. L. Moore, "Tension Tests of Steel With Test Specimens of Various Size and Form," *Proceedings*, American Society for Testing Materials, 1918, part 1, p. 403.

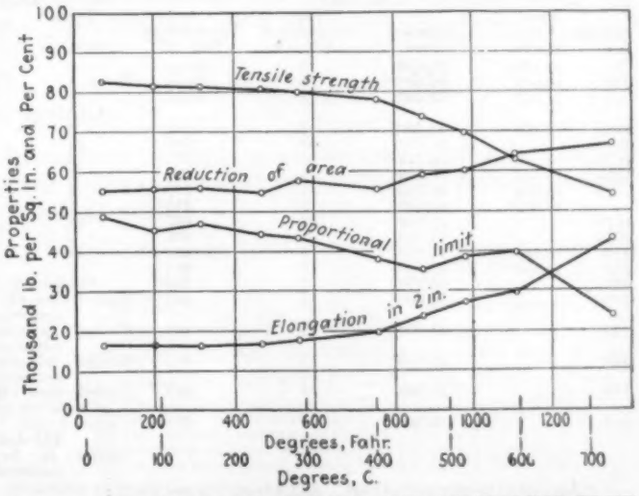


FIG. 5—EFFECT OF TEMPERING AND ANNEALING BLUE-ROLLED BOILER PLATE. (FIREBOX GRADE)

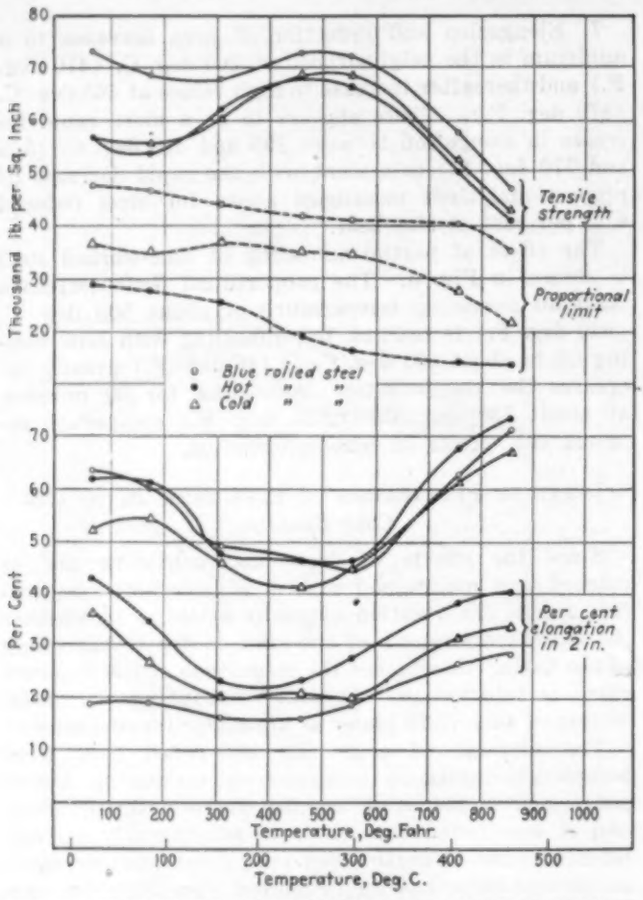


FIG. 6—TRANSVERSE PROPERTIES OF FIREBOX PLATE AT ELEVATED TEMPERATURES AFTER VARIOUS WORKINGS

It is at once evident that the general form of the tensile curves is similar to those for longitudinal tests with the exception of the limit of proportionality, which does not increase with first rise in temperature. Duplicate determinations do not agree as well as those obtained under similar conditions in longitudinal samples. The increase in transverse tensile strength at room temperature resulting from blue- or cold-rolling is very much less than that observed in longitudinal tests for the same mechanical reductions. Similarly the increase in proportional limit and decrease in ductility resulting from deformation at room temperature or blue-heat are less than the effects observed in longitudinal tests. The proportional limit of steel deformed cold or at blue-heat is raised more than is the transverse strength, but this difference is not so marked as in tests made on longitudinal samples.

PERMANENT DEFORMATION PRODUCED BY STRETCHING

Huston[8] found that in loading bridge iron to just above the "so-called elastic limit" the ductility or toughness remained unaffected so that the metal would yield with every small increase in load. When stressed just below that point, the iron became rigid and would not elongate without a decided load increase.

From a large number of tests of wrought iron and low-carbon steel Bauschinger found that when subjected to overstrain at ordinary temperatures certain things occurred: When stretching was produced by a load between the proportional limit and yield point, the former was raised. An applied stress greater than the yield point resulted in a decrease in the limit of proportionality, a loss which was recovered upon aging for a long time at room temperature or for shorter periods at higher temperatures. This aging effect was counteracted by high heating, but the method of cooling was observed to play an important part—high heat and rapid cooling being most effective. Aging after heating and cooling exerted no further effect.

Howe ("Metallurgy of Steel") reported that stretching at room temperature lowered the limit of proportionality of steel, often to zero. The effect of rest was slowly to restore the elasticity and finally raise it above the load that caused the previous deformation, but this occurred more slowly at room temperature than when the steel was warmed.

Muir[9] found that the elastic recovery of overstrained steel was as marked after 3 or 4 minutes at 100 deg. C. as in 2 weeks at room temperature and was impeded or entirely prevented at lower temperatures around 0 deg. C.

Howard[10] stated that "the effect of straining hot on

[8] "Effect of Continued and Progressively Increasing Overstrain Upon Iron," *J. Frank. Inst.*, January, 1879, p. 41.
[9] "On the Overstraining of Iron," *Philosophical Trans.*, Royal Society of London, A 193, p. 1, A 198, p. 1; *Proceedings*, A 77, p. 277.
[10] *Iron Age*, vol. 45, p. 585 (1890).

TABLE I—EFFECT OF OVERSTRAIN ON FIREBOX BOILER PLATE (SERIES I STEEL)

	First Load			Aging		Final Tensile Properties				
Sample No.	Prop. Limit Found	Imposed Load	Time Maintained, Minutes	At Temperature, Deg. C.	Time, In Minutes	At Temperature, Deg. C.	Prop. Limit	Tens. Str.	Elong. in 2 In.	Red. of Area	At Temperature, Deg. C.
J9	30,300	39,650	5	Room	5	Room	35,700	58,700	39.0	48.1	Room
J10	30,600	40,000	5	Room	5	Room	Very low	58,450	42.0	48.8	Room
J16	24,000	40,000	5	Room	5	Room	37,000	58,100	42.0	47.7	Room
					at 1,550 lb. per sq.in.						
H26	13,500	30,000	5	295	5	295	28,000	65,900	23.5	41.5	295
H20	.....	16,250	44	295	45	295	17,800	65,800	24.8	35.2	295
H22	.....	16,250	42	295	8	295	17,100	66,000	24.8	42.6	295
H24	15,500	16,250	5	295	5	295	16,400	64,300	27.0	41.5	295
H25	15,000	16,250	5	295	5	295	.....	.....	.....	.....	.....
	56,000*	64,800*	5*	295*	5†	295†	56,250	66,340	26.8	40.3	295
H21	.....	13,960	42	407	43	407	13,400	50,450	37.3	59.9	407
H23	.....	13,960	45	407	5	407	15,750	53,300	34.8	54.3	407
J11	16,600	31,400	5	463	5	463	15,500	44,300	35.0	64.3	463
J17	16,600	25,000	5	463	5	463	23,000	43,600	39.0	63.0	463
J23	.....	32,900	5	295	Cooled 1 hr. to room		Very low	58,600	35.0	47.0	Room
J15	.....	30,000	5	463	Cooled then 46½ hr. at room temperature		36,500	59,100	32.5	48.0	Room
J21	.....	25,000	5	463	Cooled 30 min. to room temperature		No curves	58,450	37.5	48.1	Room
J20	.....	25,160	5	463	Cooled 40 min. to room temperature		.....	59,200	38.5	48.7	Room
J18	.....	25,000	5	463	Cooled; then 45½ hr. rest at room temperature		35,500	59,600	39.0	48.7	Room
J19	.....	30,000	5	295	Cooled 3 min. Normalized 843 deg. C. Cooled 2½ hr. to room temperature		32,000	58,250	40.5	50.7	Room

* Amount at twenty-second load. All loads maintained 5 min. at 295 deg. C. † Specimen aged 5 min. at 295 deg. C. after release of each load.

the subsequent strength when tested cold appears to depend upon the magnitude of the straining force and the temperature when overstrained. There is a zone of temperature in which the effect of hot-straining elevates the elastic limit above the applied stress and above the primitive value, and if the straining force approaches the present tensile strength there results a material elevation of that value when cooled. After exposure to higher temperatures a gradual loss occurs in both elastic limits and tensile strength, and generally there follows a noticeable increase in the contraction of area." Howard found the zone of elevation of the elastic limit had apparently been passed when the steel was subjected to overstrain at about 395 to 425 deg. C. (740 to 800 deg. F.) and noted the importance of time between overload at high temperatures and subsequent test.

Because of the extended field for research along these lines the tests of overstrained steel noted in Table I made by the author were limited to the region about the blue-heat, for the most marked changes in tensile properties have been found in this temperature range.

At blue-heat [295 deg. C. (565 deg. F.)] tensional stress in excess of the limit of proportionality raises this limit in a short time after release of load to a value approximating the stress producing the previous deformation (samples H26, 20 and 22); but when this stretching at blue-heat is followed by cooling to room temperature and subsequent test (sample 33) the immediate effect of the "blue-overstrain" is a lowering of the proportional limit.

Repeated overstrain at blue-heat, whether at constant or increasing loads, raises the apparent limit of proportionality at this temperature in a like manner and to a similar degree. The magnitude of this increase may be considerable. Sample H25 had its proportional limit raised from 15,000 lb. per square inch in steps to a little more than 56,000 lb. per square inch, or 375 per cent, by 22 loads constantly increasing in intensity.

TABLE II—CHANGES IN ELASTIC LIMIT IN COMPRESSION UPON AGING

Tensional Stress Applied			Proportional Limit in Compression at Room Temperature*	
Lb. Per Sq.In.	At Temperature, Deg. C.	Overload Beyond Proportional Limit, Lb. Per Sq.In.	Time After Tensional Overstrain, Hours	Average Proportional Limit
45,000	20	13,800	28	13,250
			52	11,250
45,000	295	22,550	3	19,500
			6	19,800
			30	17,500
			49	17,000
			54	14,700
30,000	463	17,500	3	15,650
			29	17,650
			48	21,000
			71	24,000

* Size of compression sample: ¾ in. diameter, 1½ in. long. Gage length of 1 in. used. Samples cut from 1-in. marine boiler plate. Average compressive limit of proportionality at room temperature was 23,750 lb. per square inch. Two samples were tested for each age.

Such deformation does not, however, appear to modify the values of tensile strength, total elongation or reduction of area when the specimen is finally broken. These results appear consistent with Bauschinger's deductions and the work of others mentioned for a very rapid recovery from elastic overstrain; almost immediate elevation of the proportional limit would be expected at the temperature at which the stresses were applied.

Heating to a temperature above Ac_1 and thereafter cooling steel which has been overstrained at blue-heat (sample J19) immediately restores the apparent elasticity of the metal at room temperature. Such thermal treatment does not lower the limit of proportionality, which in a test at room temperature remains at a value approximating the previous overload at blueness.

Metal previously overstrained at moderate temperatures regains its elasticity after rest at room temperatures (samples J15, 18, 20 and 21). It is not quite clear whether the immediate effect is to destroy the elastic properties, but such is probably the case.

Rosenhain in his "Introduction to Physical Metallurgy" states that the hardening of steel by plastic strain is unidirectional and that a piece of steel which had attained an apparently raised proportional limit as a result of tensile overstrain was really weakened in compression. Therefore the total range of elasticity, from the limit of compression to that in tension, had not been materially altered. To test this deduction samples of marine boiler plate were subjected to stretching at several temperatures beyond the limit of proportionality and then tested in compression (Table II). The effect of such tensional overstrain at room temperature, blue-heat and about 465 deg. C. (865 deg. F.) is a lowering of the limit of proportionality in compression when tested at room temperature. When the steel is permitted to rest, the samples stretched at blue-heat or below show a gradual decrease in the compressive limit of proportionality as time passes by, a fact which, taken in conjunction with the rise in proportional limit in tension, indicates that the range of elasticity is not altered, but merely shifted. Steel similarly stretched at 465 deg. C. behaves differently, however, for with age the proportional limit in compression rises for 70 hours until it approximates its original numerical value.

Calculating the Gravity of Liquid Petroleum Products

Since publishing the announcement of the American Petroleum Institute's new scale for reporting the gravity of liquid petroleum products,[1] some question has arisen as to how this scale differs from Baumé standard for liquids lighter than water. As has been previously pointed out, the difference lies merely in the fact that the conversion modulus for the A.P.I. scale is 141.5 instead of 140.

The formula on which the standard American Petroleum Institute scale is based in terms of "degrees A.P.I." is as follows:

$$\text{True sp.gr. } (60/60^\circ \text{ F.}) = \frac{141.5}{131.5 + \text{deg. A.P.I.}}$$

$$\text{or Deg. A.P.I.} = \frac{141.5}{\text{True sp.gr.}(60/60^\circ \text{ F.})} - 131.5.$$

The formula on which is based the U. S. Baumé scale for expressing the true specific gravity of liquids lighter than water (other than petroleum) in "degrees Baumé" is as follows:

$$\text{True sp.gr. } (60/60^\circ \text{ F.}) = \frac{140}{130 + \text{deg. Bé.}}$$

$$\text{or Deg. Bé.} = \frac{140}{\text{True sp.gr.}(60/60^\circ \text{ F.})} - 130.$$

The relation between the two scales at 60 deg. F. is:

$$\text{Degrees A.P.I.} = 1.010714 \text{ Deg. Bé.} - 0.10714$$

Thus 10° Be. (140 mod.) corresponds to 10.0 A.P.I. (141.5 modulus)
30° Be. (140 mod.) corresponds to 30.2 A.P.I. (141.5 modulus)
50° Be. (140 mod.) corresponds to 50.4 A.P.I. (141.5 modulus)
70° Be. (140 mod.) corresponds to 70.6 A.P.I. (141.5 modulus)
90° Be. (140 mod.) corresponds to 90.8 A.P.I. (141.5 modulus)

[1] "The A.P.I. Scale for Reporting the Gravity of Liquid Petroleum Products," *Chem. & Met. Eng.*, vol. 26, No. 24, p. 1120, June 14, 1922.

Metaldehyde as a Fuel

An Interesting Account of the Manufacture and Properties of a New Solid Fuel Developed for Household Use by Swiss Electrochemists

By H. Danneel

MANY types of solid fuel have appeared on the market. At the outset soaps were used as the solidifying medium for the alcohol to which shellac, stearine, tallow and stearic acid were sometimes added and from which the oleic acid was eliminated so as to obtain better burning. Subsequently collodion and cellulose acetate were used for solidifying the spirit[1] and also the jel made from agar agar.[2] Large quantities of these and similar fuels were used during the European war and some little post-war demand for them has been established because, in spite of their defects, they are more convenient to use than is liquid alcohol. The chief fault with most forms of solidified spirit is found in the volatility of the alcohol, which necessitates the use of air-tight vessels. Otherwise evaporation would take place and the calorific value of the fuel would be impaired. The fact that solidified spirit liquefies when ignited renders it unsuitable for many purposes and the residual ash is sometimes considered an objectionable feature.

Apart from the above, paraformaldehyde and hexamethylenetetramine have been recommended as fuels. After the flame of the former has been extinguished it gives off vapors of formaldehyde, not easily forgotten by anyone who came too close to them. Hexa was scarcely more than an emergency product during the war, for the cost of the raw materials formaldehyde and ammonia is comparatively high. Its cost is further increased by a manufacturing loss amounting to almost one-half of the raw materials. The characteristics of hexamethylenetetramine as a fuel are for the most part satisfactory, if objection is not taken to the fact that it is soluble in water. Certain other materials have also been recommended as fuels but have not acquired industrial importance.

A new and rather promising solution of this problem appears to have been arrived at recently by a Swiss firm, the Usines Electriques de la Lonza of Basel, which is producing a fuel from metaldehyde, a substance to which, up to the present, only scientific importance was attached. Its manufacture on a commercial scale has been rendered possible through the synthetic production of acetaldehyde from calcium carbide.

Discovery and Properties of Metaldehyde

Metaldehyde was discovered by Liebig,[3] its existence confirmed by Fehling[4] and its properties were investigated by Kékulé and Zincke.[5] It is formed as a by-product when acetaldehyde is transformed into paraldehyde by the action of acids or salts. At ordinary temperature a solution of very small quantities of metaldehyde in paraldehyde is obtained but at low temperatures small quantities of solid metaldehyde are obtained in the shape of fine white needles which can be increased in size if the process is carried on slowly.

Metaldehyde does not melt under atmospheric pressure and starts to sublime without melting between 112 and 115 deg. C. In a closed tube it is said to melt at 160 deg. C. (Roozeboom 184 deg. C., Hollmann 167 deg. C., Smith and de Loeuw 246 deg. C.). Metaldehyde, when impure, gradually volatilizes in the form of acetaldehyde when left in the open air, particularly during hot weather. In confined spaces it changes into paraldehyde. When chemically pure, it is a substance of practically permanent stability. Its molecular weight corresponds to the formula $(CH_3COH)_4$. The heat of combustion amounts to about 6,000 cal. per kg.

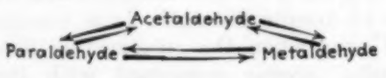
In the majority of solvents metaldehyde is but little soluble; for instance carbon bisulphide, acetone, glacial acetic acid and water. Acetaldehyde dissolves but 0.25 per cent at 19 deg. C., paraldehyde dissolves but 0.06 per cent at 12 deg., boiling alcohol 1.8 per cent, boiling ether 0.5 per cent and benzine at 23 deg. dissolves a maximum of 13.5 per cent.

Acetaldehyde-Metaldehyde-Paraldehyde Equilibria

The interesting instance of three polymorphous substances, whose transformation into one another can be greatly accelerated by catalysts (pure acetaldehyde is known to keep for a long time without changing into paraldehyde), has invited investigations of the processes from a physical and chemical point of view.[6] From these as well as from numerous tests made in connection with the commercial manufacture of metaldehyde, the following conclusions can be made:

1. If acetaldehyde is subjected to the action of catalysts at ordinary temperature, it polymerizes. The quantities of catalysts required are exceedingly small; 0.1 per cent and less has been found to suffice.

2. The polymerized substances formed are paraldehyde and metaldehyde and the reaction proceeds with a speed determined by the strength of the catalyst until an equilibrium is established, which equilibrium depends on the temperature but not on the nature of the catalyst. The reactions which lead to the equilibrium are three in number, that is to say—acetaldehyde ⇄ paraldehyde, acetaldehyde ⇄ metaldehyde, paraldehyde ⇄ metaldehyde—and might be illustrated by the schematic formula:



The reaction which starts from pure acetaldehyde to which has been added the necessary quantity of catalyzing agent leads at 15 deg. C. to a liquid mixture of the three substances in which paraldehyde preponderates to the extent of about 92 per cent. Metaldehyde can clearly form to a very slight extent only, at all

[1] D. R. Pat. 134,721.
[2] Br. Pat. 24,146 (1901).
[3] *Ann.*, vol. 14, p. 141 (1835).
[4] *Ibid.*, vol. 27, p. 319 (1838).
[5] *Ibid.*, vol. 162, p. 145 (1872).
[6] R. Hollmann, *Z. Physik. Chem.*, vol. 43, p. 129 (1903). R. Smith and H. L. de Loeuw, *ibid.*, vol. 77, p. 269 (1911).

events in smaller quantities than are required for a saturated solution in paraldehyde (i.e. 0.06 per cent). In intermediate phases too, there are no visible signs of the formation of metaldehyde when the reaction proceeds at 15 deg., which proves that the quantity present in these intermediate stages does not exceed that which can be taken up by acetaldehyde, that is to say 0.25 per cent.

3. At low temperatures the circumstances are different. The solubility of metaldehyde in acetaldehyde decreases with the temperature, and by a judicious choice of catalysts it can be brought about that temporarily more metaldehyde is formed than can be retained in solution by acetaldehyde or by paraldehyde, in which case metaldehyde would be precipitated as a solid body. The final equilibrium, however, would not in any way be altered, so that toward the end of the reaction the precipitated metaldehyde would again disappear. There are a number of substances which appear relatively to accelerate the reaction. Acetaldehyde → metaldehyde to a greater extent than the simultaneous reaction acetaldehyde → paraldehyde. Only such substances, of course, are of value in connection with the manufacture of solid metaldehyde, and among them are nearly all of the strong acids, particularly sulphuric acid and also a few salts. It is clear that the reaction product must not be left to itself too long and that the process has to be interrupted when the maximum quantity of metaldehyde has been formed, because otherwise it would practically disappear again.

Manufacturing Difficulties

In the course of manufacture a number of difficulties are met with, some of which it has not been found an easy matter to overcome. First of all, there is the selection of the best catalyst. A given substance can influence in different ways the three reactions which have to be considered. It can, for instance, accelerate reaction 1 and exert no influence on 2 and 3, or even retard them. It can accelerate all three reactions or two of them, leaving out the third one, so that from a mathematical point of view, 24 combinations are possible. Moreover, the effects of the catalyst are modified in various ways by the temperature. Cases are known where a catalyst does not act at a temperature below 10 deg. C., but exerts a very marked action at higher temperatures. A much stronger action in fact than might be expected from the temperature coefficient of the speed of reaction, which is generally assumed to be 1/5. Ultimately the solubility of metaldehyde in paraldehyde, acetaldehyde and mixtures of these two depends on the temperature and determines the precipitation of metaldehyde. Its dependence on the temperature, however, is not the same as that of the efficiency of the catalysts. When working at very low temperatures, there is also the risk of paraldehyde, which has a solidifying point of 12.5 deg. C., solidifying. Therefore it would appear that although metaldehyde is metastable at ordinary temperature, it has to be guarded during the course of manufacture against transformation into paraldehyde or acetaldehyde.

The regulation of the temperature during the manufacturing process is not a simple matter. The reaction is exothermic and in large reaction vessels the temperature can easily rise locally. Unless it is distributed at once a local acceleration takes place in the formation of paraldehyde, accompanied by further rises in the temperature, so that the reaction may assume the nature of an explosion. Within a few minutes the total contents of a large reaction vessel may be brought to the boiling point, an occurrence which has to be guarded against by all means, in view of the flammability of acetaldehyde.

Preparing It for the Market

When the maximum quantity of metaldehyde has been precipitated, the reaction product is treated in a hydro-extractor and freed from the liquid, which consists mainly of paraldehyde with small quantities of acetaldehyde. This liquid is transformed into acetaldehyde and again enters the process unless it is desired that it be worked up into pure paraldehyde.

Metaldehyde, such as it is obtained in the above process, is not suitable for consumption as a fuel. It consists of small needles, the size of which is inversely proportional to the speed of formation. When dry, it forms a voluminous powder which so readily ignites that its use would involve some risk in the household. It moreover develops a strong flame and burns away quickly, so that it is impossible to utilize fully its calorific value. By compressing it strongly into convenient shapes, it has been found possible[1] to render it suitable for the purpose in view. When so treated, metaldehyde does not ignite as quickly as alcohol, but requires a few tenths of a second's contact with the flame of a match.

Shaped metaldehyde exhibits peculiar symptoms when burning. It is not the metaldehyde itself which feeds the flame, but acetaldehyde which is formed from it by the heat radiated by the flame. The fuel, therefore, is surrounded by a zone of cool gas which prevents the flame from touching the fuel itself. This, together with the absorption of heat necessitated by the transformation of metaldehyde into acetaldehyde, keeps the fuel itself cool, so cool in fact that it is possible to extinguish the flame by the palm of the hand without risk of injury from burning. The transformation into acetaldehyde during the burning process regulates itself; as soon as volatilization becomes more intense the flame is removed from the solid block and there is less radiated heat and the volatilization is automatically checked. Compressed metaldehyde is characterized by its steady and uniform flame.

Why Impure Compound Is Most Satisfactory

The influence of the catalyst during the combustion process is more noticeable in connection with metaldehyde than it has been with any other kind of fuel. When metaldehyde such as comes from this process, that is to say in an impure condition, is pressed into shapes, the resulting fuel exhibits traces of the characteristic acetaldehyde smell, even when not exposed to heat. This indicates that a slow decomposition of metaldehyde is taking place. This smell becomes very marked during a few minutes after the flame has been extinguished, a thing that would not happen with pure metaldehyde. This is due to the action of minute particles of the catalysts adhering to the metaldehyde crystals. These impurities can scarcely be measured and probably amount to only a few millionths of a per cent, so that an elimination would be much more troublesome than other means to counteract the influence of the catalyst. Such means would consist in depriv-

[1] Metaldehyde compressed as fuel patented in 20 countries. Br. Pat. 144,589, Swiss Pat. 84,746, U. S. Pat. 1,407,101.

ing the catalyzing agent of its efficiency by neutralizing the acid and transforming, for instance, sulphuric acid into barium sulphate, hydrochloric acid into silver chloride, or by treating sulphuric acid with ammonia and transforming it into ammonium sulphate, which is inert. Another way would be to eliminate the liquid phase—a course which is facilitated by the fact that metaldehyde is neither hygroscopic nor soluble in water.

But supposing metaldehyde were entirely free from a catalyzing agent, such as could be obtained by sublimation in a vacuum, or recrystallization, or such as would be obtained by depriving the catalytic agent of its efficiency, the combustion would show new and undesirable phenomena. Such a pure product ignites only with difficulty and, in contrast with the impure product, the flame touches the fuel, which becomes hot, and when extinguished, clouds of sublimed metaldehyde can be noticed floating in the air in the shape of a fine fluff. Moreover, the sublimation would tend to clog delicate parts of a burner, such as the delicate regulating devices used in some applications.

It is evident, therefore, that for a metaldehyde fuel a catalyzing agent is required to influence the combustion process, while for the storage of the fuel it is not wanted and not even desirable. For that reason a means has been found to render the catalyst inert at temperatures below 30 to 40 deg. C., and at the same time allow its active properties to become evident at temperatures of 60 deg. and above. This temperature is produced by the heat radiated from the flame, and when the flame is extinguished and the temperature falls the catalyst again becomes inert. In that way it has been found possible practically to do away with the odor, which for that matter might have been disguised or modified by the addition of certain scenting materials. Furthermore, this is accomplished without interfering with the desirable effects on the combustion process.

Basel,
Switzerland.

Rapid Methods for Determining Endurance Limits

A report of progress from the British National Physical Laboratory (abstracted in *The Iron and Coal Trades Review* for June 30, 1922) notes that the method of predicting fatigue ranges of stress which has hitherto been employed at the laboratory has been by means of a series of tests on different specimens (usually six) at different ranges of stress, commencing with a range well above the fatigue limit so that fracture occurs after a comparatively short number of reversals, and then progressively diminishing the range of stress for the other specimens until fracture fails to occur with a number of reversals of the order of five to ten millions. It is then comparatively easy by means of plotting to predict the limiting range of stress. This method, although otherwise satisfactory, is slow and costly and several attempts have been made by workers in this field to predict the fatigue range of stress from a test on a single specimen of the material. One method is that due to Dr. J. H. Smith, who has found that by attaching an optical extensometer to a specimen under reversals of tensile stress, the stress-strain curve obtained, under gradually increasing range of stress, exhibits a "yield-point" characteristic similar to that found in static tests, and that the range of stress corresponding to this yield point is the true fatigue range of the material.

A calorimetric method has been devised by Mr. Stromeyer for use in alternating torsion tests. In this method the specimen under test is water-jacketed and the temperature of the circulating water carefully observed. The torsional fatigue limit is determined by noting the stress at which a small but perceptible rise of temperature of the jacket water due to the heating of the specimen by internal work takes place. In the experiments carried out during the year both of these methods were used simultaneously on the same specimen under alternating tension, the chief modification being that instead of using a water jacket the temperature of the specimen was determined by a thermo-junction. Satisfactory agreement between the two methods and the results of fatigue tests on the material by the ordinary Wöhler method have been obtained for the case of a wide range of materials.

The method of "yield ranges" has also been extended to tests on specimens subject to reversals of bending stress in the ordinary Wöhler fatigue testing machine. A plane mirror is mounted on the end of the specimen with its plane perpendicular to the axis of rotation. The changes in the slope of the plane of the mirror, due to gradual increases of the load on the specimen, are observed by means of a source of light and a long optical lever (40 yards in length). On plotting the results on a base of stress range a "yield point" can be detected at a stress range which is identified with the fatigue range of the material. By means of these methods the time necessary to predict the limiting range of stress has now been reduced to less than half an hour.

Phosphorescence

Sir George Beilby, in his recent book on "Aggregation and Flow of Solids," describes a number of experiments going to show that certain types of phosphorescence are due to the molecular movement or displacement which is produced by heat, by mechanically applied stresses or by radiant energy. Certain other types of phosphorescence are distinguished by their appearance in three stages, called by him primary, secondary and revived phosphorescence. These can be explained as due to atomic changes in which chemical affinity is the controlling factor. Furthermore, a species of electrolysis occurs in solids exposed to the beta or cathode rays; the products of electrolytic dissociation are insulated or partly insulated from each other by the neutral molecules as in a viscous electrolyte; and it is the breaking down of this insulation and the recombination of the ions which cause revived phosphorescence.

Forging and Working Invar

Invar steel is very difficult to work mechanically but is an important alloy for certain classes of work where very low coefficient of expansion is desired. In order to see whether it could be worked successfully, four small ingots of invar were prepared by the Metallurgical Division of the Bureau of Standards. The first attempt at forging was unsuccessful, the ingot cracking and breaking under the forging press. The second attempt was quite satisfactory as a result of very careful handling during forging operations.

It was found necessary to give very light reductions and not allow the forging temperature to drop below 1,000 deg. C. during the first reduction. This ingot was forged to a $\frac{3}{4}$-in. rod, and a portion of this was cut off and machined to a $\frac{1}{4}$-in. rod. This has been cold drawn with two intermediate annealings down to approximately $\frac{1}{16}$-in. wire.

Chemical Lead And the Causes of Its Technical Failure

An Analysis of the Effect of Various Impurities on Physical Properties and Technical Value of Chemical Lead

By Thomas French

DURING the last 50 years a considerable amount of research work has been devoted to "chemical lead." Although many facts with examples of faulty lead have been collected and many theories have been formed to account for the defects commonly occurring in lead, much still remains to be done, especially work of an academic nature. At the time Percy published his metallurgy of lead, in 1870, both the Pattinson and Parkes processes for the desilverization and purification of lead were in general use, and although the reasons underlying the separation of the various impurities in each case were not then so well established as they are now, the practical application of the processes was much the same as at the present day.

Parkes vs. Pattinson Process of Lead Refining

At all the large smelting works, desilverization by the Parkes process is almost universal on account of its lower cost, but there are still a few of the smaller smelting works in Europe that retain the Pattinson process because of the simplicity of its operation. Still more of the refiners of lead, not necessarily smelters, retain the Pattinson process in order to refine the lead to the grade required for the manufacture of white lead by the Old Dutch process, for which it is necessary to have a very highly refined lead, and in a lesser degree for the manufacture of red lead and litharge. Litharge for assayer's purposes, in which the silver has been reduced to a few grains per ton, is also made from lead that has been desilverized by the Pattinson process.

Effect of Addition of Bismuth to Purified Lead

There are certain elements that are not removed in refining lead by the Parkes process, notably bismuth, which unfortunately ranks as the most objectionable of all the impurities that occur in lead. Lead of "corroding" grade is generally required to contain not more than 0.05 per cent of bismuth. It is doubtful, however, if bismuth has the bad effect on white lead that is so often attributed to it. White lead of the best quality has been made by the Old Dutch process from an otherwise highly refined lead but containing more than 0.1 per cent bismuth, which was purposely added, with no observable bad effect or retardation of the corrosion. It is said, however, that the bismuth becomes concentrated in the residue of lead that remains after corrosion has stopped and that the grooves in the flat grinding stones quickly become filled with it, making grinding difficult. For other white lead processes such highly refined lead as is used for the Old Dutch and chamber methods is not necessary. For the manufacture of red lead and flake litharge, the bismuth content of the lead must be low, otherwise the color will be dirty and the flake litharge will not break down properly on weathering, resulting in a large proportion of hard lumps which must be sold at a less profitable price.

For concentrating sulphuric acid by means of lead pans there is not the slightest doubt that bismuth causes the acid to attack the lead at a very much lower temperature than when purified lead is used, and although it has by no means been definitely proved, the opinion is general that in "chamber" lead its presence is also very undesirable.

The cost of refining lead or desilverizing by the Pattinson process is somewhat more than by the Parkes process. This is unfortunate, as the Pattinson process removes bismuth from the lead and concentrates it in the uncrystallized portion containing the silver and other impurities. On the other hand, the Pattinson process removes copper very imperfectly, while the zinc used in the Parkes process has a great affinity for copper. For both processes the removal of copper is effected by a particular modification of the softening or improving process, previous to the desilverization. American lead is usually contaminated with bismuth to a much greater extent than European or Australian lead and were it not that the cost is more, the Pattinson process would be much more suited to the refining of American lead than the Parkes process. Should the demands of the user of lead become more exacting with regard to the presence of bismuth, it is possible that the American smelter may be forced to use a combination of the Parkes and Pattinson process. It is probable that the cost of the Pattinson process may be considerably reduced by a different and simpler arrangement of the plant than that of the Rozan and more modern modifications.

Variation in Analyses of the Same Lead by Different Men

There is very little information published as to the extent to which lead may be purified by either the Pattinson or Parkes process. It is generally understood that with the exception of bismuth, Parkes lead is purer than Pattinson and it is probably the case that for an equal removal of silver in an ordinary refined lead, Parkes lead is purer. There can be little question, however, that for extreme purification the Pattinson process is superior to the Parkes, judging mainly by the physical properties of the extremely refined leads.

It is a costly and by no means an easy matter to make a reliable analysis of a refined lead. When it is remembered that the total impurities comprising probably a dozen ingredients may amount to less than 20 mg. when 200 g. are used for analysis, the difficulty will be more readily appreciated. Some of the impurities, such as bismuth for instance, may be determined with a fair degree of accuracy. Silver by the cupellation method is held by many to be more accurate than by wet analysis. If each constituent could be gone after individually from a fresh solution of the lead there would be some chance of obtaining an accurate result, but when one after another of the constituents is determined in the same solution, with so many evaporations, the use of reagents which are by no means as pure as might be expected and with contamination by dust and the other things incidental to an analysis, the final result can be only approximately correct. It is,

in fact, quite common to obtain from different analysts analyses of the same sample of lead that have only the remotest likeness to one another. A. G. Betts, in his "Lead Refining by Electrolysis," gives examples of analyses of the same sample of lead, by three chemists, as follows:

PER CENT OF IMPURITIES

	Fe	Zn	Sb	Cu	As	Bi	Ag
A	0.00023	0.0004	0.0007	0.00043	0.00005	None	0.00003
	0.00032	.....	.....	0.00045	.....	....	.....
	0.00040	.....	.....	0.00045	.....	....	.....
B	0.0022	0.0079	0.0013	0.0013	0.0065	....	0.00016
C	0.0037	0.0042	0.0007	0.0012	0.0092	....	0.0003

Another example quoted by the same author of a sample analyzed by two analysts is as follows:

PER CENT IMPURITY

	Cu	Sb	Fe	Sn	Ag
A	0.0003	0.0060	0.0003	0.0049	0.0006
B	0.0020	0.0010	0.0046	0.0095	0.0006

In the latter instance it will be noticed that as regards copper, A's result is nearly 7 times less than B's; antimony, 6 times more; iron, about 15 times less, and tin about half as much, while silver, which was probably determined by dry assay, is the same in both cases.

An analysis of a refined lead, including a blank of the reagents used, usually requires about three weeks to perform. The difficulty, unreliability, time and expense of making an analysis of a refined lead are no doubt among the principal reasons for the small advance that has been made in our knowledge of the properties of lead.

Remarkably Consistent Properties of Lead From Different Refineries

It is remarkable how invariable the different well-known brands of lead on the market are as regards their physical properties. Australian "Brokenhills," Spanish "Pennaroya" and Perth Amboy leads each have their own characteristics which remain unchanged over a long period of years. Considering the variety and impurity of the ores from which the lead has been derived, the constancy of the refined lead must be admitted to be largely due to the particular method of treatment that the work lead has undergone as regards softening previous to desilverizing, method of desilverizing and subsequent refining. None of these leads is capable of resisting the action of 96 per cent sulphuric acid at the boiling point of the acid. Before that temperature is reached the lead is violently converted into sulphate of lead and sulphur is deposited, with the evolution of sulphurous acid and hydrogen. After subjecting these leads to further purification by the Pattinson process they are almost unaffected by the boiling acid, only a few bubbles of gas being observed and almost no conversion of the lead into sulphate after a considerable time. Usually, four crystallizations of the lead are sufficient to give this result and a further crystallization through another four pots makes little difference, although the physical properties of the lead are thereby improved.

Lead when refined to this degree solidifies in the mold into which it is cast with a highly colored surface characteristic of pure lead and with the crystals on the surface very well defined and in large aggregates. When a small sheet of this lead that has been cast into a mold and not rolled is subjected to the action of dilute nitric acid, these aggregates of crystals are slowly eaten around, the eutectic being eaten away more rapidly than the crystals. Lead has the power of dissolving oxide of lead when very hot. This oxide of lead is given up very completely when the lead is slowly cooled, but it may be that a minute quantity separates between the crystals and is attacked more readily by the acid.

Addition of Impurities to Refined Lead

If this highly refined lead, crystallized eight times, is alloyed with a small quantity of another metal to the amount of about 0.1 per cent, the action of the nitric acid is increased and a difference in the behavior of the metal added is discernible. That with antimony dissolves most rapidly and is accompanied by a black deposit; bismuth comes next, then copper. Arsenic and silver are very nearly equal to copper. Zinc, cadmium, tin and sodium are a little better than copper, and the alloy with aluminum is best of all.

When subjected to the action of strong sulphuric acid, the alloy with bismuth is attacked when only moderately heated and if the heating is continued the lead is violently converted into sulphate. The alloy with silver and that with antimony come next and are violently attacked. Arsenic stands the action much better than silver and antimony. Cadmium, tin, aluminum, copper and sodium are about equal and still better, while zinc stands the action better than all the others.

Tests such as these on alloys of very pure lead with a very small quantity of another individual metal are, however, of little value for practical purposes, for when more than one metal in small quantity is added to the lead, the action of the acid appears to be quite different. The one metal apparently has an inhibitory or corrective effect on the other. Thus, when copper is present along with bismuth, it withstands the action of the acid very much better. This has been dealt with by D. W. Jones,[1] who gives the effect of the addition of various small amounts of copper to chemical lead. It should be remembered, however, that the chemical lead with which he experimented is of a much more impure quality than the highly refined lead referred to above.

Failure in Sulphuric Plants Often Due to Poor Management

The causes of failure due to defective lead are very varied. Lead used for chamber work may be quite satisfactory, while the same lead used in a concentrating pan may be worthless. For chamber work the sheet lead may have local defective parts which shorten its life, but usually the life of a chamber depends on the extent to which the production of acid is forced and on the management. Of two plants using exactly the same sheet lead for the construction of sulphuric acid chambers, one usually produced about four times as much sulphate of lead as the other.

The principal cause of the solution of the lead is generally considered to be the presence of an excessive quantity of nitric acid, in place of nitrogen trioxide and peroxide. If this is so, a pure lead should stand the action much better than an impure lead, but this deduction must be modified by the fact that the presence of air will accelerate the action, whereas the surface film of sulphate of lead that is formed will decrease it. Thinning of the sides of the chamber usually takes place near the top of the chamber and near the bottom. Sheets have been rolled thicker at the top and bottom for this reason, with good results. Pitting and roughening of the sheets is a very common defect and long irregular corroded channels

[1] *J. Soc. Chem. Ind.*, vol. 39, p. 221 T.

similar to those often met with in lead pipes that have been lying underground, subject to electrolysis, are also common. Analysis of the lead in these cases gives little information as to the cause of corrosion. In any case, the analysis of one part of a sheet of lead may be quite different from that of another part, for the impurities in a block of cast lead are not disposed equally throughout its mass. The end sheets rolled from the block may be very different from the middle, as regards distribution of the impurities.

Behavior of Lead in Concentrating Pans

In concentration pans the acid is kept at a temperature very little above 200 deg. C., while the melting point of lead averages about 325 deg. C. Pans often give way suddenly after a few days' use and sometimes only after they have been in use for a long period. The contents of the pan suddenly become milky through the formation of sulphate of lead and sulphur, accompanied by a rise in temperature, and a large hole is rapidly eaten through the pan. The addition of cold weak acid appears only to aggravate the action, probably on account of the heat developed. Usually in such cases the cause will be found to be the presence in the lead of either bismuth or antimony.

William Beaumont Hart gives an example[3] of a pan which he states was made of Pattinson lead which had been crystallized three times, and contained, among other impurities, a trace of antimony, 0.003 per cent bismuth and 0.0014 per cent copper. Five days after starting the pan, without any known cause and without evolution of gas, the pan started to leak. Its contents became milky and a gradual slow action was observed. The remaining contents of the pan were analyzed, showing the acid to have a specific gravity of 1.551 at 15 deg. C. and a strength of 63.8 per cent sulphuric acid. Among the impurities present in this acid there were bismuth 0.2247 per cent; zinc 0.0759 per cent; copper 0.0941 per cent; silver 0.0471 per cent, and a trace of antimony. From the cubic capacity of the cavities that had been eaten away he calculated that the original lead at these parts must have had a percentage composition as follows: Bismuth, 0.1250; copper, 0.0523; silver, 0.0262; zinc, 0.0422, and a trace of antimony. He remarks that it may happen that the bismuth accumulates at certain parts and may exhibit itself in certain shapes in the sheet rolled or cast, the fractured surface of which is sometimes covered with a black coating, or the bismuth-lead alloy may exude from the metal in fluid condition. Further investigation in this direction would probably lead to interesting results.

Effect of Dirt and Oxide on Lead

It is well known that the presence of dirt and oxide of lead skimmings is responsible in many cases for the breakdown of sheet lead. Oxygen in lead may be responsible for many failures, but Lunge and Schmidt, who investigated this, concluded that the percentage of oxygen in lead is very slight even in extreme cases and does not seem to have any connection with its liability to be acted on by acid. By a special method of analysis devised by them, they found that ordinary soft lead contains an average of 0.0024 per cent of oxygen. They made numerous attempts to increase the quantity of oxygen artificially but never got beyond a maximum of 0.005 per cent. As this slight difference in percentage is not connected with a perceptible difference in the action of sulphuric acid, the oxygen hypothesis, they say, must be abandoned.

It is presumed that by their reference to oxygen in lead they mean the compound of oxygen and lead. Metallic lead when red hot is capable of dissolving a very considerable quantity of oxide of lead, especially when melted under litharge. In this way at least 1 per cent of oxide, which contains ten times as much oxygen as was found by Lunge and Schmidt, may be introduced into lead. On slow cooling the whole of the dissolved oxide apparently separates and rises to the surface. When the cooling is rapid the oxide has not time to separate and is interpersed throughout the mass, but quite unalloyed with the lead. On hammering a small block of lead treated in this way, it shows innumerable cracks wherever the oxide has separated. If rolled it results in laminations of lead separated by films of litharge, in extreme cases so thick that it drops out when the lead is handled. Sheet lead and pipes have at times more of this entrapped oxide of lead than might be expected and there can be little doubt that to it is due the difference in the behavior of sheets rolled from the same brand of lead.

Process of Rolling Sheet Lead

In making sheets, the pigs of lead are loaded into a large cast-iron melting pot which is provided with a spout at the bottom for running off the melted lead. After the lead is melted and skimmed it is run into a mold placed at a lower level and forms a large block from 6 to 9 in. thick weighing 10 tons upwards. When cold enough it is lifted by means of a crane and transferred to the rolling mill. The rolls are slightly cambered and during the rolling the lead increases very slightly in width and elongates only in the direction of its length. After the block has been reduced considerably in thickness by the rolls it is cut into short lengths, the width of the rolls, and it is then usual to run each length through the rolls at right angles to the previous direction. When the sheet has become so much elongated that it is too long for the rolling table, it is doubled over and the rolling continued, a little chalk having been placed between the sheets to prevent them from adhering to one another. Finally the rough edges are cut off and the sheet is trimmed to the required size and made into rolls for the market.

When the lead is melted a considerable amount of granular scum, composed partly of dirt but mostly of oxide of lead, rises to the surface. Molten lead, like mercury, is very difficult to clean and by continued stirring it is always possible to bring a little more scum to the surface. In practice the lead is skimmed only once and occasionally a small lump of oxide, which may either have been adhering to the side of the pot, or trapped in the spout, passes into the mold and remains below the surface of the lead. Pieces of sheet lead that have failed from this cause are sometimes found with channels and streaks eaten away at right angles to one another when transverse rolling of the piece of lead has taken place. This has been proved by immersing a small lump of oxide in the middle of a block of lead. After rolling into a sheet and submitting to the action of acid for some time, a long channel was eaten away, similar to those which are commonly met with after the thin film of the metal which covered it has dissolved or worn away.

After the lead has been tapped from the melting pot into the mold it cools gradually or, if it is required

[3] *J. Soc. Chem. Ind.*, 1907, p. 504.

at once, the cooling is hastened by pouring water on it. The lead shrinks away from the mold and in the center it sinks, forming a large hollow in which usually the surface of the lead is continuous or unbroken. There are occasions, however, on which the lead has solidified too rapidly on the surface away from the center and in this case there will be found a mass of disrupted crystals in the hollow which penetrate the lead to a considerable depth. These crystals instantly acquire a film of suboxide. A freshly cut surface of lead welds together very thoroughly with pressure, but with the slightest oxidation film welding is impossible. When a sheet is rolled from a block such as this, there will be found in it a large part that will give unsatisfactory results in practice and especially if the sheet is subjected to vibration it will soon exhibit weakness.

Other Causes of Failure

Apart from the presence of impurities probably the chief cause of failure of sheet lead and pipes is due to admixture of oxide of lead, as previously mentioned. The lead in the melting pot is frequently made red hot and the surface of the lead then oxidizes with extreme rapidity and acquires a thick layer of flaky oxide of lead, which is dissolved by the lead near the surface. This lead saturated with oxide finds its way into the mold when sufficient time has not been allowed at a lower temperature for its separation. Although the lead in the mold crystallizes out free from the dissolved oxide, each crystal group is enveloped in oxide of lead. On rolling, these crystals cohere very imperfectly and give rise to the brittleness of the lead which is sometimes noticed in the lead boxes that are made to contain sulphuric acid for export. The small quantity of hydrogen evolved by the action of the acid on the lead gives sufficient pressure to form numerous cracks and the lead becomes so brittle that a slight blow causes it to break. The oxide is often observed when the sheet lead is scraped or cut by a sharp knife.

Failures of sheet lead sometimes occur for which the quality of the lead is not responsible, such as when lead is in contact with mortar, or when the sheets are subject to the vapors of acetic acid and carbonic acid gas. This latter condition sometimes exists when sheet lead is used on the roofs of bonded stores or distilleries. The lead in this case is gradually converted into white lead, as all the elements for the formation of the latter are present. There are numerous other isolated cases, some of which are easy to explain while in others only time and more data will afford a solution.

Chemical Specification for Cast-Iron Pipe

Although there has never been a general agreement between manufacturers' and users' associations on the correct chemical analysis of cast-iron pipe, discussions at a recent meeting of the American Water Works Association foreshadowed an agreement on sulphur limit at 0.10 or 0.12 per cent. At this meeting F. A. McInnes read an interesting paper on causes of failure, in which he remarked that analyses of metal from some of the pipe in the Boston waterworks that has been found broken or cracked during the past 20 years show some "horrible examples." Omitting extremes, the remaining analyses, particularly those in which the sulphur is abnormally high, warrant the conclusion that the quality of the iron was a contributing if not a direct factor in the failure of the pipe.

Cohesion

Rigidity is the outstanding characteristic of a solid, according to Sir George Beilby[1]. "During the past 20 years enormous strides have been made in the study of the ultimate structure of the atom, and in particular the experimental study of the disintegration of the radioactive elements has thrown an entirely new light on interatomic energy. This energy is now known to be of so high an order compared with the molecular forces previously known that many physicists have come to regard these latter as merely residual effects of the interatomic energy. However true this may be, the fact remains that in matter as we know it and as it affects our daily lives, cohesive force must always remain its most fundamental endowment." He describes experiments showing that filings of all metals, when small enough, adhere to each other or to flat surfaces with sufficient force to overcome gravitational attraction. Particles of zinc 0.033 mm. diameter and less will stick to the under side of a plate glass; of gold, 0.133 mm., silver 0.165 mm. and copper 0.099 mm.

"All the experimental researches on the properties of matter at low temperatures go to show that while the qualities of extension and mass which are common to matter in all its forms are unaltered by the removal of heat, the outstanding characteristic of the solid state, rigidity, becomes more and more pronounced as the absolute zero of temperature is approached. In other words, the physical properties which depend on cohesion show by their steady development as the absolute zero is approached that in a heatless universe cohesion would hold undisputed sway. In this universe the diverse properties of the majority of the elements as we know them would be entirely latent; the radioactive elements alone would continue by their disintegration to pass the product of their interatomic energy into a universe in which it would be dissipated and disappear entirely.

"With the advent of heat the all-powerful grip of cohesion is relaxed and the latent potentialities of matter begin to unfold. The waves of ether-borne energy, as they stir the responsive vibrations of the molecules, are to dead matter as the first breath of approaching spring is to the sleeping buds. As among the trees of the forest the response is more ready in some than in others, so among the elements, the lighter and more easily energized, like hydrogen and helium, are already far on in their development toward the ideal freedom of the gaseous state before the less responsive, like platinum and carbon, show any signs of stirring from their lethargy. In the more slowly energized elements we can study the earlier steps in this development, and I think we are now entitled to say that one of the first of these is the acquirement by the molecules of the power of automatic crystalline arrangement."

Fertilizer Used on Cotton

The Department of Agriculture has estimated that commercial fertilizer was used on almost exactly one-third of this year's cotton acreage, or on about 11,500,000 acres. On the average 249 lb. of fertilizer was applied per acre and the total fertilizer used was about 1,429,000 tons. This had a total value of $42,121,000, or $29.48 per ton. This was equivalent to a cost of $3.69 for each acre on which fertilizer was used.

[1] "Aggregation and Flow of Solids," MacMillan Co.

A New Vessel for the Absorption of Hydrochloric Acid*

A Discussion of the Principles Underlying the Absorption of Gases — The Presentation of a New Absorber and the Illustration of Its Use in Hydrochloric Acid Production

By STEPHEN L. TYLER
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THE absorption of hydrochloric acid gas in water at first sight seems to be a very simple proposition. The gas is highly soluble in water and it would seem that simply bringing together the gas and the absorbent would readily result in complete absorption.

The problem, however, is not quite as simple as it would first appear. The solution of hydrochloric acid gas in water is one which is highly exothermic and the solubility of the gas is inversely proportional to the temperature. As an example of this, it is possible at a temperature of 0 deg. C. to dissolve over 500 volumes of the gas in one volume of water, while at a temperature of 60 deg. C. less than 350 volumes of gas can be dissolved in one volume of water and at a temperature of 110 deg. C. only about 160 volumes may be retained by one volume of water.

CONDITIONS FAVORING ABSORPTION

The solution of hydrochloric acid gas in water is dependent upon the following conditions:

1. The temperature of the gas and the liquid.
2. The concentration of the gas in the gases to be scrubbed and the concentration of the acid liquid to be produced.
3. The time of contact between the gas and the liquid; the average distance between the gaseous particles and the liquid particles; the thickness of the liquid layer and its movement internal and as a whole.

Three general methods suggest themselves for bringing about intimate contact between gas and absorbing liquid:

1. Spraying the liquid into the gas.
2. Bubbling the gas through the liquid.
3. Contact between liquid and gas by a distribution of the liquid over relatively large surfaces.

The first method mentioned above is not practical nor efficient in the case of hydrochloric acid because of the high heat of solution and the difficulty of removing the heat generated. By this first method only acid of low strength can be obtained. The second method, while reasonably satisfactory from the standpoint of producing acid of good strength, is impractical from the mechanical standpoint when the apparatus is designed for the removal of heat because of the highly corrosive nature of the gas to be handled and the pressure encountered. Thus we have left only the third method or the direct exposure of the liquid to the gas for the satisfactory production of a high strength hydrochloric acid.

TWO METHODS IN USE AT PRESENT

At the present time two general methods are used for bringing about this intimate contact between the soluble gas and the absorbing liquid. One of these methods employs stoneware vessels (tourills) so designed that a relatively large surface of liquid is exposed to the gas. These vessels are also designed for cooling. The second method uses the vertical tower with a suitable packing material over which the absorbing liquid is passed, thus exposing extremely large surfaces of absorbing liquid to the gas. This latter method is used extensively where gas concentrations are low.

The tourill type of plant is satisfactory for the production of the higher strengths of acid and the design of the apparatus is such as to allow of satisfactory cooling and surface exposure of the absorbing liquid to the gases. There is, however, the objection that this plant requires much floor space and necessitates many connections to maintain a circulation of both liquid and gas. The tower has been used extentively for the absorption of hydrochloric acid gas, but from this it is possible to produce only acids of low strength, as it is not practical to construct absorption towers with sufficient cooling to keep the tower temperature down to a point where high strength acid may be produced.

PRINCIPLES INVOLVED IN THE NEW ABSORBER

A new type of absorption vessel has recently been developed. The general design of this vessel is shown in Fig. 1. It will be seen that the vessel follows the general design of the S-bend, but has broadened body (3), which is flattened so as to give large surface with relatively small volume. There is a dam or weir (4) at one end of the lower surface which retains a certain quantity of liquid in the bottom of the vessel, thus making this a small reservoir. By following the S-bend principle, the pieces would be set up vertically one above the other, the socket (2) receiving the spigot (1) of the vessel following, thus making an absorption system which amounts to practically nothing more than a single conduit through which both the gases and liquid pass and which has pockets or reservoirs to retain a certain amount of the liquid. Thus the third method of bringing about the intimate contact between the gas and the absorbing liquid is used, but all of the

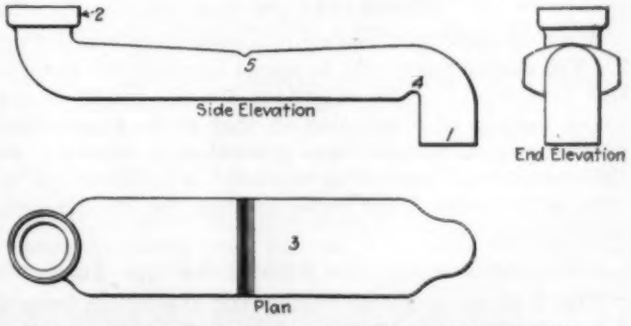


FIG. 1—GENERAL DESIGN OF ABSORPTION VESSEL

*Paper presented before the American Institute of Chemical Engineers at Niagara Falls, Canada, June 21, 1922.

objections to the other types of apparatus have been removed by the elimination of small tube connections for maintaining the circulation of the absorbing liquid. These connections have been made generally of glass with rubber as the packing material and have been a very objectionable point, especially because of the fact that they were located necessarily below the level of the absorbing liquid and a leak was certain if breakage occurred or the packing deteriorated.

At the central portion of the roof of the vessel there is a low point (5) toward which the vessel slopes from either end. This sloping of the roof will deflect the gases downward upon the absorbing liquid and bring about very intimate contact. There will be a certain amount of liquid condensed out from the gases as well as some of the liquid run over from the absorption vessel immediately above, which will drip off at this point, making substantially a liquid curtain through which all of the gas must pass. This dropping of liquid on to the absorbing surface has the added advantage that it brings about a complete agitation of the absorbent and thus materially increases the absorption. In absorbing soluble gases in liquids, agitation of the absorbent will always increase the efficiency. There is

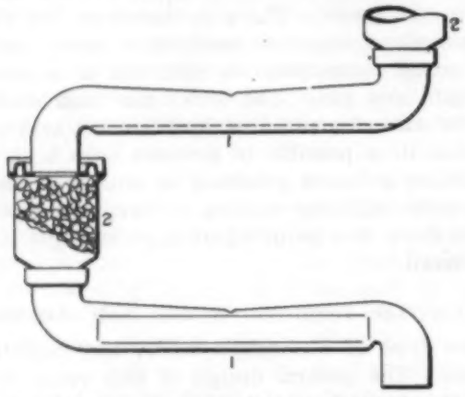


FIG. 2—APPARATUS WITH SMALL ABSORPTION TOWER INSERTED FOR LOW CONCENTRATION OF GAS

also further agitation when the absorbent flows from one vessel to the other, as there is a vertical drop of several inches.

With gases of higher concentration, surface exposure alone is better adapted for their absorption. Therefore the type of vessel just described, if used alone, is more suited to such gases as are generated from the pan side of a "salt-sulphuric" hydrochloric acid plant. In cases where the hydrochloric acid gas concentration is low the same type of absorption vessel may be set up in much the same manner but with interposed packed towers of larger section than the pipe connections themselves.

Modification of New Apparatus for Low Concentration Gas

A set-up showing these short towers is shown in Fig. 2. The packed tower (2) is placed between two absorption vessels (1). The objections already raised to the tower method of absorption in that it does not allow of the removal of the heat generated is overcome in this method of employing towers. The absorbent is thoroughly cooled in its travel through the intermediate absorption vessels.

Suggested Absorption System for Pan Gases

Fig. 3 shows a typical cooling and absorption system for hydrochloric acid produced from the gas generated

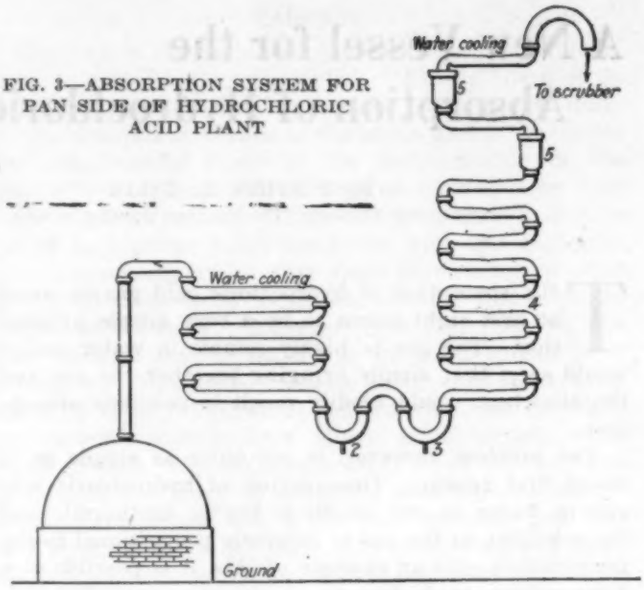


FIG. 3—ABSORPTION SYSTEM FOR PAN SIDE OF HYDROCHLORIC ACID PLANT

on the pan side of the pan and roaster type of plant. It will be noted that the gas first passes through a water-cooled condenser (1) which will remove much of the condensable vapors and lower the temperature of the gas. The condensate produced in this line runs off from a trap (2). The gas passes on through a second trap (3) and up into the absorption system (4). The absorption system operates on the reflux principle so that the strongest gas is in contact with the strongest acid. In the upper portion of this, where the gas concentrations are much lower, towers (5) are interposed between the absorption vessels so as to remove as much as possible of the soluble gas. The gases passing on through this upper portion of the absorption system are carried over to the final scrubbers. The acid produced in the absorption system is taken off from trap (3). The entire absorption system would be thoroughly water-cooled to prevent a rise in tempera-

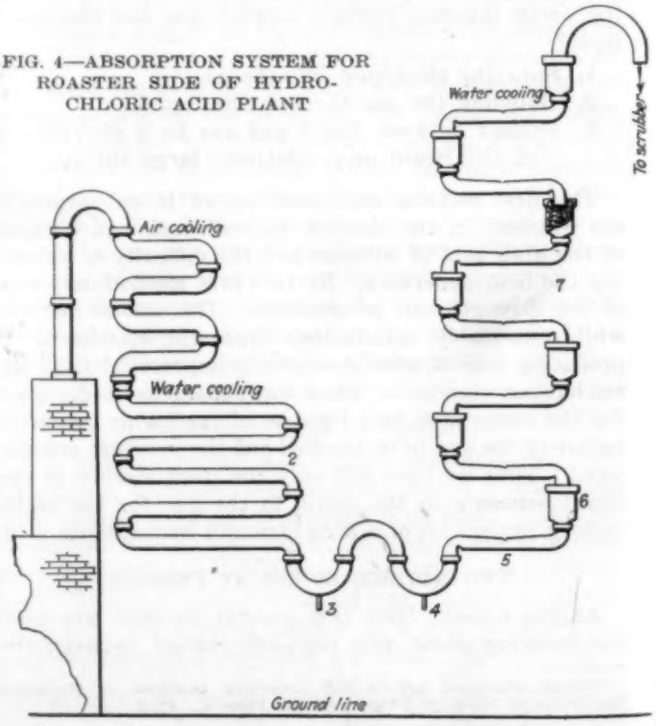


FIG. 4—ABSORPTION SYSTEM FOR ROASTER SIDE OF HYDROCHLORIC ACID PLANT

ture due to the absorption and to insure the production of acid of good strength.

System Modified for Absorption of Muffle Gases

Fig. 4 shows the general design of a cooling and absorption system for the hydrochloric acid gas produced on the roaster or muffle side of the plant. The gases leaving the muffle are first conducted through a series of S-bends (1) which are air-cooled only; then through a second series of S-bends which are water-cooled (2). In this latter set of condensers, the condensable vapors are removed and the gas is cooled. The condensate from both of these coolers is carried off through the trap (3). The gases pass forward through another trap piece (4) and up through the absorption system (7) which is composed entirely of absorption vessels (5) with intermediate towers (6). The exit gases from this absorption train are carried over to a scrubbing system which may consist of another absorption system similar to the one shown or may be a stoneware tower, depending considerably upon the ultimate use for the acid produced.

The type of hydrochloric acid absorption equipment with which this paper deals is designed to be made of fused silica. For such work as this, fused silica is especially well adapted inasmuch as it is insoluble in the acid and thus the product cannot be contaminated. The wall thickness of pieces made up of fused silica is much less than that obtained in any other ceramic material, thus tending toward increasing the efficiency of the cooling and consequently reducing the size of the plant. Such equipment is relatively light in weight so that light supports are ample.

Summary

In summing up the points brought out regarding the type of absorption equipment described, the following points are worth notice: Light weight; economy of floor space; complete agitation of absorbent; liquid curtain through which gas must pass; no joints below liquid level; no glass tube connections or rubber joints; thorough cooling of gas and liquid; intermediate towers give all advantages of tower absorption with none of the disadvantages; complete distribution of cooling water over large cooling surface.

Other uses for the absorption vessel are apparent but the following are possibly worth mentioning:

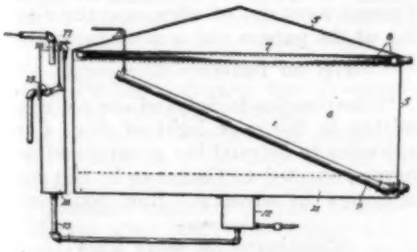
1. As absorber for soluble gases other than hydrochloric acid.
2. For bringing about reactions of gases upon solutions, emulsions or suspensions. An example of this would be some of the chlorination reactions. In this sort of work, the use of the intermediate tower should considerably increase the efficiency of the plant.
3. For the concentration of volatile liquids of boiling points approximately that of water.
4. For fractional distillation of liquid mixtures.
5. As condenser for such vapors as nitric acid where surface exposure to the hotter gases is desirable to insure uniformity of product. The large surface exposure as well as the intimate contact between the hotter still gases and the condensate produced when operating on the reflux principle would give an acid of very good quality and color.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Prevention of Evaporation of Stored Liquids.—Petroleum oils and other similar volatiles are often held in storage for considerable periods of time. The invention covered by this patent aims to prevent evaporation from oils and other similar liquids when so stored. In this invention evaporation is to a great extent prevented by maintaining on the surface of the liquid a covering blanket of froth, the gaseous constituent of which may be air or an inert gas. This also serves to reduce greatly the fire hazard. The accompanying drawing shows the piping used with this invention for distributing the froth-forming substance over the top of the stored liquid. This froth-forming substance can be obtained by dissolving a suitable amount of animal gelatine in water together with a small percentage of a soluble preservative agent as mercuric chloride. (1,415,351; Frank A. Howard, C. I. Robinson and James M. Jennings, assignors to Standard Oil Co. of N. J. May 9, 1922.)



Fertilizer and Process of Making Same.—Graham Edgar of Washington, D. C., has developed an improvement in fertilizer manufacture and assigned it to the government. It relates to the use of calcium cyanamide and tricalcium phosphate in the production of fertilizer containing both fixed nitrogen and phosphoric acid in available forms. It could not be done previously because calcium cyanamide is not effectively converted into urea when treated with acids in the presence of diluents and neutralizing substances such as calcium phosphates, except when the ratio is about 10 to 1. Also because the effective conversion of calcium cyanamide into urea in the presence of acid phosphates occurs only at temperatures of 70 or 80 deg. C. Under these conditions a considerable loss of available phosphoric acid occurs due to the transformation into soluble phosphates. This has limited the amount of calcium cyanamide used in fertilizer mixtures to about 6 per cent. Mr. Edgar's process develops the fact that it is necessary first to treat the calcium cyanamide with strong mineral acids in an amount substantially in excess of that necessary to neutralize the lime content and to maintain a substantial excess of mineral acid throughout the reaction and finally to allow the process to come to completion before adding such diluents and neutralizing substances as bone meal, phosphate rock and potassium carbonate. Urea is very much less decomposed in the presence of strong mineral acids than in the presence of diluents or weekly acidic substances, and therefore higher temperatures may be employed for the reaction as carried out above.

After the reaction has been completed, phosphate rock sufficient to neutralize the excess acid is added. By this process it is possible to produce from calcium cyanamide a fertilizer containing 50 per cent of the total nitrogen in the form of urea and in addition to raise the ratio of urea to phosphoric acid anhydride to one part of urea to three parts of phosphoric anhydride, and may even exceed this, reaching a point where the urea will exceed the amount of phosphoric anhydride present. (1,413,013; April 18, 1922.)

Varnish Composition. — A varnish composition for use as a solvent oil may be prepared from a mixture including approximately 50 per cent by weight of pure vegetable gum, tung oil and thinners, ½ per cent of pure camphor gum, ½ per cent of lavender oil and 49 per cent of naphtha. (1,413,628; H. W. and R. W. Summers, assignors to Detroit Universal Solvent Co.; April 25, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Chemical Foundation Defended in Senate

Underwood Upholds Motives and Conduct of Garvan's Organization—Decision Against Foundation Might Be Taken as Precedent and Result in Loss of Other Benefits to Industry

INFORMATION reaching Washington indicates that the chemists and chemical industries of the country have been stirred deeply by the action taken against the Chemical Foundation. The anxiety is not confined to those interested in the chemical industries, as it is feared that Americans may lose the advantages which came with the sale of other alien property.

Another week has passed without any information having been brought out which would cause any of the chemists to desert the Foundation. At the office of the Alien Property Custodian it is stated that the suit will be filed during the first week of August.

Under ordinary circumstances there would be no objection to the suit. It is realized that there are certain legal questions which must be settled, but there is objection to the apparent timing of the action so as to influence legislation. The situation is made worse in the eyes of chemists because it seems to be one of a succession of acts by the Administration which have hurt the chemical industry during the critical period in which it has been endeavoring to establish itself on a scale commensurate with the commercial importance of the country. Several arbitrary acts have been aimed at the Chemical Warfare Service. The State Department suddenly severed its relations with the Textile Alliance. The patent convention was renewed without the adoption of the safeguards which the chemical industry advocated. Then came the action against the Foundation. All of this, combined with the prospects for the defeat of the dye embargo, make the future of the American chemical industry exceedingly dark.

Underwood Defends Foundation

During an extended discussion of the Chemical Foundation matter in the Senate, the only defense of the Administration's course was that a suit against the Foundation is necessary in order to meet the suit which the Foundation brought to establish the status of the royalties paid into the U. S. Treasury. Senator Underwood spoke effectively in defense of the Foundation. It is probable that a further defense of the Foundation will be made in the near future on the floor of the Senate, by a prominent Republican member.

Senator Underwood prefaced his remarks with the explanation that it is advisable at this time to review the facts surrounding the matter. Before he had proceeded far in his speech he was upbraided by Senator Nelson of Minnesota, chairman of the Committee on the Judiciary, for making an elaborate argument in behalf of the sale of the German patents to the Chemical Foundation. "I am astonished," he said, "that the conservative Senator from Alabama should take a case of this kind out of the hands of the courts and attempt to try it in the Senate."

To this Senator Underwood retorted: "The reason why I make this statement is not a question of trying to interfere with the courts, but I know that this attack is coming from the German lawyers in this country who are trying to get back the property of their clients." He declared that it is a mistake for the government to take this action against the Chemical Foundation. If the government succeeds in having set aside the transfer of these chemical patents to the agency created for the benefit of the American people, what is to become of the patents, he demanded. "Are you going to give them back to Germany or where do they go?" asked the Senator. "If you give those chemical patents back to Germany they go to the German cartel, a trust in Germany."

No Fraud Apparent

Senator Underwood traced the history of the legislation under which alien property was seized. He pointed out that the Germans had taken out these patents for the purpose of stifling industry in America. "The spirit of our patent laws," he declared, "had been violated, and our hospitality abused when the Germans took out those patents here for the sole purpose of building up in Germany the great industrial and war machine with which they expected to subdue the world."

The fact that A. Mitchell Palmer submitted his entire plan for the sale of the patents to the Chemical Foundation to Congress 2 months before the action was taken is evidence, Senator Underwood declared, that there could have been no fraud intended.

"This report effectually disposes of the charge that there was a fraudulent conspiracy on the part of those in the Alien Property Custodian's office," continued Senator Underwood. "The charge has been repeatedly made that Mr. Garvan, as Alien Property Custodian, sold these patents to himself as president of the Chemical Foundation. It will be seen, however, from this report, which was made before Mr. Garvan became Alien Property Custodian or had any thought of being appointed to that office, that the entire plan was devised and perfected and the sale made while Mr. Palmer was in office.

"It was Mr. Garvan's announced purpose then to resign his subordinate place in the Alien Property Custodian's office and take the presidency of the Chemical Foundation without salary or compensation for expenses, but on March 4, 1919, Mr. Palmer was appointed Attorney-General, and President Wilson, with full knowledge of the entire Chemical Foundation matter, made Mr. Garvan Alien Property Custodian. It is true that the actual assignment of the patents to the Chemical Foundation was not ready until April 10, 1919, and it was signed by Mr. Garvan as Alien Property Custodian, but as shown by Mr. Palmer's report, the entire matter had been concluded and consummated before Mr. Palmer went out of office, and the signing of the papers was a mere formality.

Aim to Prevent Monopoly

"Conspiracies to defraud are not committed in the open light of day. Conspiracies to defraud the government are never reported to Congress by the conspirators in advance. How could any

(*Continued on page* 229)

Senate Committee Splits on Muscle Shoals

As had been expected, the Senate Committee on Agriculture split in much the same manner over the Muscle Shoals proposition as did the Committee on Miltary Affairs of the House of Representatives. The Senate committee, like the House committee, was almost evenly divided for and against the acceptance of the Ford offer.

The situation differs from that in the House committee in that Chairman Norris, joined by Senators McNary of Oregon, Norbeck of South Dakota, McKinley of Illinois and Gooding of Idaho, recommends the incorporation of the Federal Chemical Corporation to operate the Muscle Shoals property for government account.

Senator Kendrick, of Wyoming, explained to the Senate that his only objection to the Ford offer is the fact that the lease period is for 100 years. He believes no lease of waterpower should exceed fifty years, the limit prescribed by the waterpower act.

American Ceramic Society to Visit Canadian Plants

Members Will Be Busy for Week Inspecting the Numerous Industries of the Dominion

Detailed plans for the Canadian summer meeting of the American Ceramic Society emphasize the fact that the week of Aug. 13 to 19 will offer unusual opportunities for the inspection of a variety of ceramic plants under most enjoyable circumstances.

The party will leave Rochester Sunday, Aug. 13, at 9:45 p.m. standard time, on the steamer Kingston, arriving in Montreal Monday at 6:45 p.m.

INSPECTION TRIPS

Tuesday, Aug. 15, will be spent in Montreal. G. Percy Cole, of the Dominion Glass Co., will be in charge of the visits to Montreal Pottery; Trenton Potteries; Dominion Glass Co.; Point St. Charles Works (bottles on Owens machine); Delorimiert Works (punch tumblers, chimneys, etc.); McGill University; Consumers Glass Co. (semi-automatic machine on bottles and tumblers); Nation Brick Co. Ltd.; Laprairie Works and Delson Junction Works; Thomas Davidson Manufacturing Co., Ltd. (enameled ware); Gurney Foundry Co., Ville St. Laurent (stove enameling, three furnaces), and the Canada Cement Company, Ltd.

Wednesday, Aug. 16, will be spent in Buckingham, Ont., with N. B. Davis in charge. On arrival at Buckingham, at 10:20 a.m. the excursion will proceed by motor to the Derry feldspar quarries. This 10-mile drive is through one of the most beautiful sections along the Lievre River. The return trip will be made in time to leave Buckingham at 4 p.m. for Ottawa.

A brief but crowded trip to Ottawa on Thursday will be under a committee composed of N. B. Davis, Howells Frechette, Joseph Keele and D. Merkley. Alternative excursions have been arranged to the Parliament Buildings; Victoria National Museum; Ceramic Laboratories, Department of Mines; paper mills and Merkley's brick plant.

VERONA, KINGSTON AND TORONTO

The party will leave Ottawa at 10:40 a.m. arriving at Verona at 2:34 p.m. Here R. F. Segsworth and Everett Townsend will be in charge and the party will be conveyed from Verona to the famous feldspar quarries of this district. A real camp dinner, cooked and served by camp cooks, is to be enjoyed in the Verona wilds.

The party will leave Verona at 6:35 p.m. for Kingston, arriving at 7:35 p.m. After a banquet by Kingston Council and a visit to the Frontenac Floor & Wall Tile Co. the visitors will leave in special Pullman sleeper for Toronto, where they will spend Friday.

The day in Toronto is being arranged by M. E. Gibson, A. N. Cote and R. K. Robertson. Their plans include visits to: Standard Sanitary Works; Dominion Glass Co.; Jefferson Glass Co.; several brick and tile companies; Toronto University and Queens Museum. Friday night will be spent in Toronto, the party leaving the next morning for Hamilton, where visits will be made to the Dominion Glass Co.; Canadian Libbey-Owens Sheet Glass Co.; General Porcelain Co.; National Fire Proofing Co. and Canadian-Harts Products Co.

Business Library to Be Selected by Industrial Leaders

Two thousand business men, one hundred national leaders in each of twenty basic industries, are selecting a representative business library to be placed in the Hotel McAlpin, New York, and to include the ten most authoritative books on every branch of business and industry.

Bank presidents, railroad heads, insurance presidents, advertising executives, textile manufacturers, wholesale grocers, department store heads and engineers are helping L. M. Boomer, managing director of the hotel, to collect this library. The bibliography will be made available to chambers of commerce and other business organizations.

The library when completed will comprise the ten most authoritative books covering the fields of Insurance, Banking, Textiles, Groceries, Railroads, Shipping, Automobiles, Iron and Steel, Coal, Lumber, Grain, Rubber, Shoe and Leather, Department Stores, Clothing, Advertising, Printing, Paper, Accountancy, Credit, Sales Management, Publishing, Foreign Trade, Building, Heating and Ventilating and Furniture.

The method of selection is to analyze the lists received from the one hundred leaders in each industry and thus select the books which are mentioned the greatest number of times. The ten books in each field most often selected will be those included in the library. The lists will be re-submitted to a committee of experts for further voting if there is not sufficient unanimity of opinion.

I. C. C. Ruling on Cyanamid—Sulphur Rates Protested

Deciding the complaint of the American Cyanamid Co., the Interstate Commerce Commission hold that the rates on cyanamid from Suspension Bridge, N. Y., and Niagara Falls, Ontario, Canada, to San Francisco, Los Angeles and other Pacific coast destinations in California are unreasonable. It prescribes reasonable factors beyond St. Louis not exceeding 81.5 cents per 100 pounds and effective Sept. 6.

The Texas Gulf Sulphur Co., has entered a complaint against the rates on sulphur from Jersey City, N. J., to Baltimore, Md., and from Baltimore to Brills, N. J., on the ground that the present rates are unreasonable.

Unreasonable rates on sulphuric acid from Grasselli and Brill to Seaboard, N. J. are alleged by the Seaboard Byproduct Coke Co. of Pittsburgh. The General Chemical Co., of New York, complains against unreasonable rates on sulphuric acid from Undercliff to Maywood, N. J.

Trade Board Drops Resale Price Cases

Forty Old Complaints Quashed Since Supreme Court Has Found Practice Illegal

The Federal Trade Commission has dismissed, without prejudice to its right to institute new proceedings, about forty complaints against as many nationally known business concerns which it had charged with maintaining resale prices similar to those in what was known as the Beech-Nut Packing case.

These cases involve resale price maintenance and were suspended by the Commission to await the determination of the Beech-Nut Packing case, which case was selected and advanced by the Commission as a test case. In the Beech-Nut case the Supreme Court upheld the position of the Commission with respect to resale price maintenance.

After the Beech-Nut decision the Commission considered its suspense calendar and concluded, in view of the Beech-Nut decision and the age of the cases on suspense, that the cases suspended should be dismissed without prejudice, as it appeared to the Commission that the Supreme Court had settled the law with respect to price maintenance, and to bring these forty cases to a conclusion would involve a large expenditure of time and money and would require the amendment of the complaints to bring them down to date, and rather than amend its complaints, which would require reinvestigation, the Commission dismissed them without prejudice.

At the same time the Commission instructed its chief examiner to institute a new inquiry with respect to each of the dismissed cases and if it appeared that violations of law were found to exist within the meaning of the Beech-Nut decision, to report the facts to the Commission for determination as to whether or not new complaints should issue.

CHEMICAL COMPANIES INCLUDED

The companies against which complaints were dismissed included: The General Chemical Co., American Thermos Bottle Co., De Miracle Chemical Co., Kryptok Sales Co., L. E. Waterman Co., H. L. Hildreth Co., Massachusetts Chocolate Co., Marinello Co. of Wisconsin, Marinello Co. of Illinois, Vortex Manufacturing Co., Curtis and Co. Manufacturing Co. and Curtis Pneumatic Machinery Co., William Waltke & Co., Crescent Manufacturing Co., Goodyear Tire & Rubber Co., The Procter & Gamble Co., The DeLaval Separator Co., Buffalo Specialty Co., American Graphophone Co., Columbia Graphophone Co., The Gates Rubber Co., J. E. Hunt & Co., Pennsylvania Salt Mfg. Co., Colgate & Co., The Sheets Elevator Co., The Vick Chemical Co., Colorado Milling & Elevator Co., United Electric Co., Hillerich & Bradsby Co., Klaxon Co., D. M. Ferry & Co., Tungsten Manufacturing Co. and the Domestic Engineering Co., Inc.

Plans for Chemical Exposition Include Features Which Insure Success

Four Hundred Exhibitors Signed to Date Including Many Novelties and New Features—Society Programs and Motion Pictures Will Add to Activity

WITH over four hundred exhibitors signed up for booths at the Chemical Exposition, the success of the annual "big show" is assured. The Exposition this year will be the eighth held in New York. It has been purposely scheduled to occupy the week between the American Chemical Society meeting in Pittsburgh and that of the American Electrochemical Society in Montreal so that the month of September will be a busy one in chemical circles.

The Exposition will open on Monday, Sept. 11, at the Grand Central Palace, New York, and continue through the entire week. The exhibitors include most of the firms that have taken space in previous years and a number of companies that will exhibit for the first time. To date, five technical societies have definitely scheduled meetings to be held in the auditorium at the Exposition. Motion pictures dealing with varied phases of chemistry and engineering have been arranged for evening exhibition through the week. All in all, the 1922 edition of the Chemical Exposition offers enough of interest to the profession to occupy several days of one's time at the Grand Central Palace.

Exhibits and Exhibitors

Every branch of the chemical and chemical equipment industries will be represented among the exhibitors, as well as numerous allied houses. The chemical products which will be on display will include all varieties manufactured in the United States—coal-tar medicinals and dyestuffs, technical chemicals for the rubber, leather, paper, textile, paint, and other consuming trades. In the apparatus and machinery branches, the exhibits will take in every phase of chemical plant and laboratory equipment.

A number of new devices, developed during the past four years since the termination of war-time activity and completed since the 1921 Exposition, will be displayed for the first time this year. Many improvements on machinery long standard for industrial operations will be shown for the first time. A great many of the machines and instruments will be seen in actual operation. Something new in a special high capacity evaporator lead pump for handling phosphoric acid under pressure, a new adaptation of the hard rubber pump in hydrochloric acid loading, a recent development on a balanced automatic control valve and in a direct reading resistance thermometer, new ideas in pyrometers, developments of the past year in butyl alcohol derivatives for solvent purposes, recent developments in the use of chlorine bleach liquor in the paper industry in place of bleaching powder, new dust controlling and humidifying equipment, new ideas in loading machinery for trucks, new departures in all types of containers, steel, fiber, wood, and glass —new ideas in all branches of the industry will be on display. One of the well-known associations will display a wall chart on which will be listed every manufacturer in the United States of ordinary quicklime with a full chemical and physical description of each brand now on the market.

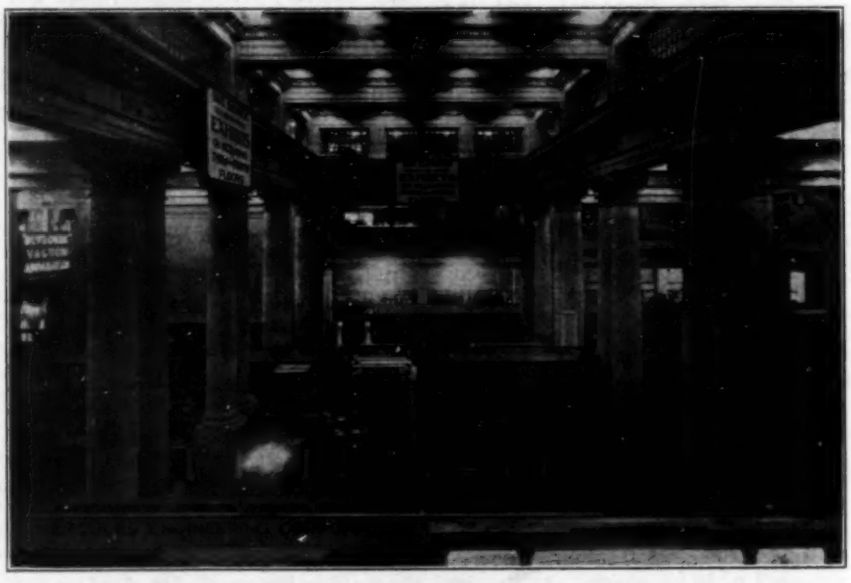
Several special sections are being planned. One will be given over to photographic materials, supplies and microscopes, in connection with the exhibit of the Technical Photographic and Microscopical Society. Another special section will be devoted to a fuel economy display which will include the products and services of nearly 100 firms. Another section will be given over to exhibits showing fire and dust explosion prevention in mills, industrial plants, grain elevators, mines and factories. This exhibit is being arranged by the Bureau of Chemistry and the Bureau of Mines. There will be shown fire extinguishing apparatus of the most modern kinds. Another novelty will be the container section, showing shipping containers of all kinds and in which packaging, labeling, package handling and shipping machinery will be exhibited.

Society Meetings

It is estimated that 100,000 persons will visit the Exposition this year from all parts of the country. Several of the societies have taken advantage of this congregating by scheduling meetings in connection with the show. Each afternoon the program will be given over to a series of events to be arranged by one of the scientific or business associations of the chemical industry, according to the plans which have been tentatively outlined. The Technical Association of the Pulp and Paper Industry, the Synthetic Organic Chemical Manufacturers Association, the American Ceramic Society, the Salesmen's Association of the American Chemical Industry, and the Technical Photographic and Microscopical Society have arranged to take care of the program for one afternoon each. The standardization program with its numerous different phases will also fill an afternoon session. The evening sessions will be given over exclusively to motion pictures, a number of which will be accompanied by lectures on various developments in the chemical and allied industries. All meetings will be held in a special auditorium in the Grand Central Palace provided for the purpose by the Exposition management.

T. A. P. P. I. Program

The Technical Association of the Pulp and Paper Industry has about completed its program. The Association is introducing a new idea in holding this particular type of meeting. The regular technical meetings of T. A. P. P. I. were formerly held each year in connection with the Exposition but the meeting this year is of a special nature. It is intended especially as an opportunity for manufacturers of equipment applicable to the paper industry to describe their products to representatives of the industry and on the other hand, for the operating men to learn of the advantages offered by the latest developments in the equipment field. Each speaker will present an idea concerning the product of his company, not with the object of hypnotizing his audience into a buying orgy



VIEW OF MAIN FLOOR OF CHEMICAL EXPOSITION

(*Continued on page* 230)

Metz, in Germany, Voices Opposition to Dye Tariff

Declares Former Enemy Plants Can Never Supplant New Industry in the U. S.

Herman A. Metz, head of Metz & Co., importers and manufacturers of dyes and synthetic chemicals, has cabled from Germany a correction of statements attributed to him on the dyes tariff.

"It is true," said Colonel Metz, "that we are importing only about 10 per cent of our dye requirements and it is true that German dye plants as well as other industrial enterprises based on a dollar calculation are worth only about 10 per cent of their pre-war capital, despite the large increases of capital stock issued by many of them. I was much amused by the comments made by a 'prominent factor.' If these 'prominent factors' and 'dyestuff authorities' only had the nerve to put their names to their statements we would soon know which of them were paid propagandists or publicity agents and which really knew what they were talking about.

Depreciation of Mark Explains Huge Dividends

"Any primary school boy can figure out the present conditions. Before the war the three largest dye and chemical (they always forget the chemical part) plants had a capital of 54,000,000 gold marks each. That equals about $12,500,000 each, for three of the plants alone, as the rest were smaller. To be worth the same amount in dollars (and certainly buildings, land, plants and processes are as good as ever in proportion) each of these three plants, putting the mark at 400 to a dollar, should have a capital of 5,000,000,000 marks, or 15,000,000,000 for the three largest. If, in view of the actual figures, you can work out a shrinkage in value of less than 80 or 90 per cent I would like to see it. And in figuring the 'exorbitant dividends' of 20 or 30 per cent, we must bear in mind that they also are paid in paper marks, and that where formerly four marks were worth one dollar, now it takes over 400 to buy one dollar or one dollar's worth of goods, and then you get from one-third to two-thirds the amount of goods you formerly got for a dollar.

Labor a Small Factor

"Of course labor, even at 30 (or 50 marks an hour, which it may soon be) is cheap compared with the United States. But bear in mind the fact that labor is only about 10 per cent of the cost of dyes and chemicals, while benzol and the main coal tar derivatives are as expensive in Germany as in the United States and the same are being bought in America, while coal, which now is largely bought in England, since France takes the German coal, is as high or higher. You get a different slant of the whole situation.

"I have not changed my views one bit and I still insist that we must have a healthy chemical industry in the United States and want sufficient tariff to give it to us; but I want to get it by honest, above-board means and not under false pretences."

Arsenic Tariff Burden Discussed in Senate

Charges that the recent duty of 2 cents per pound on arsenic adopted by the Senate in the revised tariff bill will subject the cotton growers to a tax of $18,000,000 were made in a Senate debate on the cotton schedule by Senator Smith of South Carolina. Senator Robinson, of Arkansas, also opposed the duty on the same score while Senator Smoot, of Utah, for the Finance Committee, denied that the duty would impose such a tax. He said that based on last year's imports the duty would not exceed $100,000.

Chemical Foundation Defended

(*Continued from page* 226)

conspiracy be successfully charged here in view of the fact that the Alien Property Custodian, before the final act which transferred the property, made a full and complete report of his plans and purposes and the reasons therefor to the Congress of the United States, to which wide publicity was given at the time? If the Chemical Foundation had been a strictly private institution for profit, engaged in the manufacture of chemicals, the sale to it for $250,000 would have been properly subject to attack, for it would have given for a trifling consideration a monopoly in the production of chemicals. But it was just to avoid this kind of situation that the Chemical Foundation was formed."

Trustees Control Foundation

The Senator brought out the point that neither Mr. Garvan nor the Foundation stockholders are the real controlling factors in the organization. The names of the men to whom the power is given to vote the stock and to control the corporation are as follows: George L. Ingraham, former Chief Justice of the Appellate Division of the Supreme Court of New York; Otto T. Bannard, president of the New York Trust Co.; Cleveland H. Dodge; Benjamin Griswold, Jr., head of the firm of Alexander Brown & Sons, bankers, of Baltimore, and Ralph Stone, president of the Detroit Trust Co. All of them are men whose character and standing may not be questioned by anybody in the United States. They have the voting power of the stock in their hands as trustees and control in that way the Chemical Foundation for the benefit not of the stockholders, because the stockholders merely made a 6 per cent loan, but they control it in order that there may not be a monopoly created of these patents and that anyone in the United States who is willing to pay a reasonable royalty may use the patents.

Senator Wadsworth, of New York, the chairman of the important Committee on Military Affairs, made the following statement in regard to the Chemical Foundation to the Washington correspondent of *Chemical & Metallurgical Engineering:*

"The motives of Mr. Garvan and of those associated with him in the formation of the Chemical Foundation were good and patriotic. There is no reason for attacking these men. They are sincere and have a most worthy objective in attempting to preserve and to build up a domestic chemical industry without profit or emolument for themselves.

"I have no criticism for the action of the Administration but I am very sorry that, as an incident to this legal action, the motives of the men carrying on this work have been attacked. The Chemical Foundation has performed a very valuable function. I regret the attacks on the character of the Foundation, but it should be allowed without prejudice to establish its legal right to live."

Attempt to Adopt Uniform Standard for Alcohol Determinations

At the last meeting of the Association of Official Agricultural Chemists, criticism was made of the A. O. A. C. and U. S. P. alcohol tables. The sentiment appeared to be in favor of the A. O. A. C. tables. The chairman of the committee to co-operate with the U. S. Pharmacopœial committee of revision, appointed at the last meeting, has discussed the question considerably with the conviction that a conclusion is not so easily arrived at. The committee itself is divided; two are in favor of the A. O. A. C. alcohol tables and two in favor of the U. S. P. alcohol tables.

In view of the unsatisfactory outcome so far, the chairman is submitting the matter to the A. O. A. C. membership for discussion, criticism and a vote.

It is conceded that the most convenient temperature for making routine observations is the laboratory temperature, but this temperature varies considerably from time to time and in different sections of the country. The A. O. A. C. tables are based on the Bureau of Standards table 20 deg./4 deg. and represent true specific gravities, whereas the U. S. P. tables are based on the Bureau of Standards tables 15.56 deg./15.56 deg., and are apparent specific gravities, barometer at 760 mm. with 50 per cent air saturation. The Bureau of Standards has not committed itself to any temperatures for alcohol tables or for determining specific gravities of alcoholic mixtures. The Standards Bureau has adopted 20 deg. as the temperature for standardizing apparatus. 20 deg./4 deg. is considered the more scientific, but 15.56 deg. is more largely used in the industries and by industrial chemists and 60 deg. F./60 deg. F. is written into the internal revenue law dealing with alcohol products. The Gauger's Manual tables are also based on this temperature.

Mining Engineers Honored by French Government

A. S. Dwight and C. F. Rand Decorated for Distinguished Services to Their Country and Profession

For distinguished service during the war, Col. Arthur S. Dwight, president of the American Institute of Mining and Metallurgical Engineers, and Charles F. Rand, chairman of the Engineering Foundation, were decorated with the Croix de Chevalier de la Legion d'Honneur by the French Government on July 20. The decorations were conferred by Consul General Gaston Liebert at a luncheon given in his honor at the Engineers' Club, New York City, and attended by engineering leaders from many parts of the country, including representatives of the national organizations of civil, mining, mechanical and electrical engineers and of the Federated American Engineering Societies.

In presenting the decorations, Consul General Liebert extolled Col. Dwight and Mr. Rand as personifying the spirit and service of the American engineer, which, he asserted, was a powerful factor in the victory over Germany. M. Liebert said that there was a growing friendliness between the United States and France. The two countries, he declared, have come to understand each other better since the Genoa and the Hague Conferences. The general Franco-American situation, he thought, has greatly improved since the Disarmament Conference in Washington.

Col. Dwight and Mr. Rand rank among the leaders of American engineering. Both have previously been honored by foreign governments. Col. Dwight aided in recruiting and training the Eleventh Engineers, the first unit of the A.E.F. in action, thrilling the nation on November 30, 1917, when it went to the assistance of Haig with pick and shovel during the German drive for the Channel ports. Col. Dwight served twenty-two months overseas, receiving the D.S.O. from the British, and being cited by General Pershing. He is a former alumni trustee of Columbia University, where he was graduated from the School of Mines, in 1885.

Mr. Rand is internationally known as the head of large mining properties in this country and Cuba. He discovered the great soft iron ore deposits of the north Cuban coast and has been active in Cuban railroad building. In 1913, Mr. Rand was decorated by King Alfonso of Spain with the Grand Cross of Knight Commander of the Order of Isabella Catolica for distinguished services to Spain and to mining. He is an honorary member of the British Iron and Steel Institute, of which the only other honorary members are the Prince of Wales, the King of the Belgians, Dr. Richard Akerman and Baron Gustaf Tamm. Mr. Rand is a director and past president of the American Institute of Mining and Metallurgical Engineers and as the head of the Engineering Foundation is active in promoting industrial research in America.

Plans for Chemical Exposition

(*Continued from page* 228)

but with the idea of acquainting his auditors with the merits of his product and its proper application so that the latter can judge whether or not they are taking best advantage of the production aids which the equipment manufacturers are devoloping. The program is as follows:

W. C. Edge of Paul B. Huyette Co., "Safety and Efficiency Appliances for the Boiler Plant."

E. J. Trimbey of the Trimbey Machine Works, "Trimbey & Tibbitts Proportioning and Metering System for Paper Stock."

George L. Dickey, Industrial Filtration Corporation, "Rotary Filters for Washing of Paper Pulp and for Filtering and Washing Caustic Lime Mud." (Illustrated.)

H. A. Morrison, Oliver Continuous Filter Co., "Efficiencies and Economies in Washing Black Liquor from Digested Soda and Sulphate Stock."

L. D. Mills, The Merrill Co., "The Merco Nordstrom Plug Valve."

H. S. Thayer, Atlas Electric Devices Co., "Testing Colored Materials for Fastness-to-light."

A. E. Campbell, The Schaeffer & Budenberg Mfg. Co.., "Instruments for Promoting Efficiency in the Paper Mill."

H. G. Bean, The Bristol Co., "Application of Recording Instruments in Pulp and Paper Industry."

C. C. Phelps, Uehling Instrument Co., "The CO_2 Record of Combustion Efficiency."

Harry Carlson, Sandvik Steel, Inc., "Steel Belts and Their Application to the Solution of Conveying Problems."

H. Austin, Ernest Scott & Co., "Scott Evaporator as Used in the Pulp Mill for Recovering Soda from Spent Liquors."

L. G. Chase, Yarnell-Waring Co., "The V-Notch Meter and its Application to the Paper Mill."

W. D. Mount, Glamorgan Pipe & Foundry Co., "Continuous Causticizing with Lime Recovery and Reuse."

Jerome D. Stein, Grinnell Co., "The Grinnell Dryer Applied to Wall-Paper and Coated Paper."

Hoover to Address Salesmen

The Salesmen's Association of the Chemical Industry has announced that Herbert Hoover will address its meeting at the Exposition. Mr. Hoover will talk on "Standardization, and What It Can Do for the American Chemical Industry." Wayne B. Wheeler, general counsel for the Anti-Saloon League and considered one of the foremost authorities in the United States on alcohol and prohibition legislation, and also active in the rigid enforcement of the Volstead act, will also address the assemblage on "The Attitude of the Anti-Saloon League Toward Industrial Alcohol."

Symposium on Standardization

On the "Standardization" program, tentative arrangements have secured the following speakers: W. D. Collins, United States Geological Survey, on "Moderation in Standardization"; N. F. Harriman, United States Bureau of Standards, on "Standardized Testing Apparatus"; I. G. Jennings, Glass Container Association, on "Discussion of the Reasons for the Varieties of Shapes and Sizes"; J. M. Roberts, secretary of the Apparatus Manufacturers' Association of the United States, on "What Has Been Accomplished in the Standardization of Scientific Apparatus"; Ross C. Purdy, secretary of the American Ceramic Society and chairman of the committee on refractories of the American Society for Testing Materials, on "Standardization of Fire Clays and Refractories"; Emerson P. Poste, Elyria Enameled Products Co., on "Standardization of Enameled Wares for Chemical Purposes." Other details of the program have not as yet been arranged and will be announced later, when the complete list of speakers is assured.

Motion Picture Program

An unusually interesting array of motion pictures will be shown evenings at the Exposition. The subjects covered are timely and diversified and it will be impossible to visit the Grand Central Palace in the evening without having opportunity to see a film that will be of interest to technical men in general.

One of the features of the evening programs will be an illustrated address by David Wesson on "The Romance of Cotton."

The complete program of films to be shown follows;

"Recovering Values from Fume and Smoke," by courtesy of the U. S Bureau of Mines and the Research Corporation.

"Inspiration: One of the World's Great Copper Mines," by courtesy of the U. S. Bureau of Mines.

"The Story of Sulphur," by courtesy of the U. S. Bureau of Mines and the Texas Gulf Sulphur Co.

"Mexican Petroleum," by courtesy of the U. S. Bureau of Mines.

"The Story of Heavy Excavating Machinery," by courtesy of the U. S. Bureau of Mines.

"The Story of Abrasives," by courtesy of the U. S. Bureau of Mines and The Carborundum Co.

"The Story of Air Reduction."

"The Story of Natural Gas."

"The Story of Asbestos," by courtesy of Johns-Manville, Inc.

"Fire Fighting with Foamite Firefoam," by courtesy Foamite Firefoam Co.

"The Manufacture of Newsprint Paper at the Spanish River Pulp & Paper Co. Mills in Ontario," by courtesy of the G. H. Mead Co.

"Nickel and Copper Mining, Smelting, and Refining," by courtesy of the International Nickel Co.

"Prospecting for Gold in Northern Ontario" and "Assaying for Gold in Northern Ontario," by courtesy of the Ontario Department of Mines.

Franklin Medal Presented to English Scientist

Sir Joseph J. Thomson, Master of Trinity College, Cambridge, was presented with the Franklin Medal by the Franklin Institute on July 26, in London, for his "signal and eminent service in science."

The presentation was made by the Earl of Balfour, who referred to Sir Joseph as one of the greatest pioneers in an age prolific in marvels and miracles of scientific discoveries and achievements.

In replying, Sir Joseph said he was glad if he had contributed to the brotherhood of science between Great Britain and America. He reviewed Franklin's epoch-making achievements. Franklin had attained his position among the immortals in science by a brief six years of work, and in spite of the fact that he had to the end of his life no knowledge of mathematics. Franklin was one of the most daring of adventurers in speculative science. It was his speculative contributions that had proved most valuable.

Those attending the presentation included Dr. Ellwood Hendrick, Consulting Editor of *Chem. and Met.;* Prof. T. H. Goodstead of Berkeley, Cal., and Professor W. G. MacCallum of Baltimore.

Tennessee Coal, Iron and R.R. Co. Announces Expansion

Following closely its announcement of the immediate construction of a modern 10- and 12-in. merchant bar mill at Fairfield, the Tennessee Coal, Iron & R.R. Co. announces that it will immediately construct a steel foundry at the plant of the Chickasaw Shipbuilding & Car Co. at Fairfield and remodel the Ensley foundry. The official announcement of George Gordon Crawford, president of the Tennessee company, follows:

"A modern steel foundry will be constructed at the Fairfield works of the Chickasaw Shipbuilding & Car Co. and when this is completed the Tennessee Coal, Iron & R.R. Co. will remodel the foundry at the Ensley works to improve facilities for manufacturing ingot molds and iron castings."

Personal

J. M. COBB, connected with the United States Bureau of Mines, is directing a course of first aid instruction for employees at the plant of the American Agricultural Chemical Co., Pierce, Fla. The series of lessons was commenced on July 10.

Colonel ARTHUR S. DWIGHT, president of the American Institute of Mining and Metallurgical Engineering, and CHARLES F. RAND, chairman of the Engineering Foundation, were decorated July 20 with the Croix de Chevalier de la Legion d'Honneur by the French Government, for distinguished service during the war.

J. M. GILLET, formerly in the chemical engineering department of the Goodyear Tire & Rubber Co., is now chemical engineer with the Lamberson Japanning Co., Chicago, Ill.

A. A. HOLMES has recently severed his connection with the E. B. Badger & Sons Co. and has been appointed sales manager for the American Trona Corporation, with headquarters in New York City.

ULRIC J. LEBOURVEAU of Stamford, Conn., recently resigned from the Atlas Powder Co. after 7 years of continuous service. During the last 5 years he has been connected with the research division on experimental and development work. Mr. Lebourveau has not yet made any definite plans for the future.

Dr. R. B. MOORE, chief technologist at the Bureau of Mines, has returned from a business visit to Europe.

SLOAN S. SHERRILL, formerly plant engineer for the Calumet Chemical Co. of Joliet, Ill., a subsidiary of the Calumet Baking Powder Co. of Chicago, severed his connection with that company to accept a position with the Universal Oil Products Co. of Chicago, as mechanical engineer on its operating staff. Before his connection with the Calumet Chemical Co. he was on the engineering staff of the Chemical Construction Co. of Charlotte, N. C.

LINUS S. STERRITT, general manager of the United Paper Board Co., Lockport, N. Y., has resigned, to become manager of the plant of the Eddy Paper Co., Three Rivers, Mich.

ROBERT T. STOKES, formerly assistant editor of the *Journal of Industrial and Engineering Chemistry*, is now secretary of the Biscuit & Cracker Manufacturers' Association, New York City. He succeeds the late Edward Griswold.

Obituary

T. J. MENTEN, vice-president of the Schaeffer & Budenberg Co. and the American Steam Gauge Co., died on July 9 after a brief illness. Mr. Menten was prominent for many years in the field of recording instrument manufacturers.

WILLIAM BENJAMIN SMITH, chemical engineer and inventor, died on July 19 at Washington, D. C. He invented the first grain reaper used in Georgia, and the Smith American car axle journal bearing. He made commercially profitable the use of potash from feldspar for agricultural purposes. He recently completed tests of an insecticide fertilizer which has been used in the South against the boll weevil.

The death, on July 22, of Dr. JOKICHI TAKAMINE robbed the chemical industry of one of its most brilliant leaders. But to his native country, Japan, and to his adopted country, the United States, the loss is of even greater significance, for Dr. Takamine did much to further diplomatic, as well as scientific, relations between these nations. In fact, the illness which resulted in his death may be traced directly to his distinguished service in support of the late Disarmament Conference and to his activities in welcoming the delegates of the Japanese Business Men's Mission and Baron Shibusawa's party.

Dr. Takamine was perhaps best known for his pioneer work in the field of biological and pharmaceutical chemistry. His discovery in 1900 of adrenalin, which he isolated from the glands of sheep, gave us the foundation for bloodless surgery and made possible many difficult operations on the eye, ear, nose and throat. The diastatic enzyme, takadiastase, which bears its discoverer's name, is a remedy known to physicians and chemists all over the world. These two products formed the basis for the important pharmaceutical corporations which were established by Dr. Takamine in the United States and in Japan. Among these are the Takamine Ferment Co., International Takamine Ferment Co., Takamine Laboratory, Inc., and Takamine, Inc., in this country and Sankro & Co., Ltd., in Tokyo. In addition he maintained a chemical and physical research laboratory at Tokyo and a private laboratory at Clifton, N. J.

Dr. Takamine was born on Nov. 3, 1854, the first son of a physician to the Prince of Kaga. He first took up the study of medicine at Osaka, but in 1879 was graduated in chemical engineering from the Imperial University of Japan at Tokyo. The Japanese Government sent the young chemist to study at the University of Glasgow and the Andersonian University at Glasgow. Returning home after 3 years, he was appointed chemist of the Imperial Department of Agriculture and Commerce, which position he held until 1884, when he was sent to New Orleans as a commissioner to the Cotton Centennial Exposition.

In 1885 he married a New Orleans girl, Miss Caroline Hitch, and returned to Japan, where he erected the first superphosphate works at Tokyo. He came again to the United States in 1890 and began the research work that won him his enviable position as a commercial chemist. Following the organization of the different companies to manufacture and distribute his products in the United States, he became interested in introducing a number of useful chemical industries into his native country. Thus he is accredited with having established several Japanese alkali and soda works, fertilizer plants, and dye, chemical and aluminum factories.

Dr. Takamine founded the Nippon Club of New York, the Japan-America Society and the Chemical and Physical Research Society of Japan. He was a member of the Lotos, Chemists', Drug and Chemical and the New York Athletic clubs, the American Chemical Society, the American Institute of Chemical Engineers, the Royal Society of London and the Franklin Institute of Philadelphia.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Business Revival Awaits Strike Settlement

Continued Improvement in Fundamental Business Conditions Is Threatened by Labor Troubles in Mines and Shops—Otherwise the Industrial Situation Is Promising

THE present industrial situation is fraught with difficulties which completely overshadow the importance of recent progress being made toward business improvement. Current developments appear insignificant in comparison with the serious consequences which may follow the present crisis in the coal mines and on the railroads. A crucial stage has been reached in this situation and unless the turn is for the better much of the present tide of business revival will have been stemmed.

The coal miners' and railway shopmen's strikes are beginning to pinch some of our largest and most important industries. Serious effects are being felt by the producers of steel and metal products, many of whom are curtailing their production in order to husband their dwindling supplies of coal. The banking of fifteen blast furnaces and increasing irregularities in steel production are among the early symptoms to be reported. There is scarcely a steel plant, however, that can look forward to more than a 30 days' supply of fuel. The glass and clay products and several other industries are being forced to balance production with their coal piles.

It is an unfortunate commentary on the situation that even without the railway complications, the problem of handling the amount of coal needed for next winter will tax railroad capacity to its limit. It may be safely predicted that if the government's plans do not shortly result in coal production and expeditious transportation, all business will be embarassed and industrial revival will suffer a serious setback.

Unemployment No Longer a Factor

It should be recognized, however, that notwithstanding these labor difficulties there has been a consistent and general improvement in fundamental business conditions. Unemployment, except for the voluntary kind, is no longer a factor in the situation. In fact certain industries, notably iron and steel, automobile, construction and farming, have reported actual labor shortages. The U. S. Employment Service made a survey in July embracing 355 principal industrial centers, and a predominating proportion of these reported improvement. Of 65 leading cities, 52 had more workers employed July 1 than on June 1. There were but 13 decreases and these were all in centers affected by either the textile or the coal strike. In 8 of 12 major manufacturing industries there were increases in the number of persons employed. The largest, 32.1 per cent, was for iron and steel; car building and repairing with an increase of 30.5 per cent was a close second, while the automobile manufacturers reported an increase of 21.2 per cent.

Were it not for the coal strike the railroads would be handling a volume of freight traffic larger than for any year since 1920. From the low point of 706,713 cars for the week of April 15, revenue freight loadings increased to 877,856 cars for the week of June 24—the highest for the year. For the week ended July 15 car loadings were 860,907, which represents an increase of 86,023 cars over the corresponding week of 1921. This also shows that during its second week the shopmen's strike had no noticeable effect on freight movement.

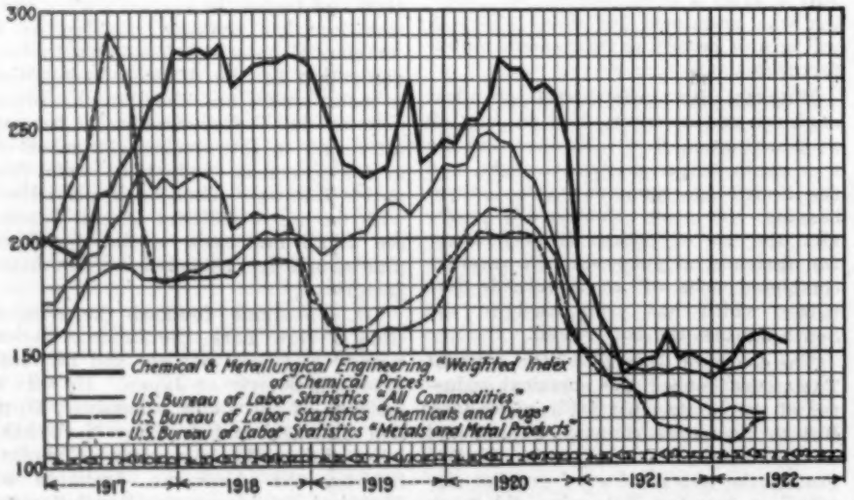
Business failures, which in January, 1922, had attained a new high record of liabilities, $115,301,371, have since fallen, and for June were $38,412,782. This is the smallest for any month since October, 1920.

Stocks and Exchanges

The financial situation continues to be favorable, with an abundance of money available at low rates of interest. Security values after a slight recession during June have begun moving up again. This upward trend of representative railroad and industrial stocks is shown in the following compilation of *Wall Street Journal* averages, which has been made by the Irving National Bank:

	20 Railroads	20 Industrials
Highest for 1919 (May)	$91.13 (Nov.)	$119.62
Highest for 1920 (Nov.)	85.38 (Jan.)	109.88
Highest for 1921 (Jan. 15)	77.56 (Dec. 15)	81.50
Lowest for 1921 (June 20)	65.52 (Aug. 24)	63.90
Highest for 1922 (July 6)	87.58 (May 29)	96.41
Lowest for 1922 (Jan. 9)	73.43 (Jan. 10)	78.59
Previous low	64.30	60.38
January 3, 1922	73.48	78.91
June 1, 1922	85.23	96.03
June 12, 1922	81.81	90.73
July 1, 1922	84.45	92.90
July 17, 1922	86.55	95.26
July 22, 1922	86.41	95.78
July 27, 1922	87.63	96.36

The foreign exchange market has been erratic during the past month,



THE TREND OF WHOLESALE PRICES FOR CHEMICAL AND METALLURGICAL PRODUCTS, 1917-1922

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	153.56
Last week	153.58
August, 1921	158
August, 1920	264
April, 1918 (high)	286
April, 1921 (low)	140

Included in this index are acetic, citric, hydrochloric, nitric and sulphuric acids, ethyl and methyl alcohols, ammonia, ammonium sulphate, barium chloride, bleaching powder, borax, caustic potash, caustic soda, copper sulphate, formaldehyde, glycerine, potassium carbonate, salt cake, soda ash, sulphur, benzene, aniline, cottonseed and linseed oils.

but except for the German mark, the principal foreign currencies ended the month in a better condition than on June 30. Almost complete demoralization of the Berlin exchange on July 7 forced the value of the mark down to $0.0018¼, a new low level for all time. Following the French negotiations with Great Britain and the possibilities of lowered reparations and a 2-year moratorium, the value of the mark rose to 23c. per 100 on July 12. This level was not long maintained, however, and on July 26 the mark again fell to $0.0019.

Price Trends

Because of seasonal variations and the effects of temporary market conditions, a single month is often too short a time to compare the trend of commodity prices. The Federal Reserve Board's index number based on 100 representative commodities increased from 158 in May to 162 for June. The extent of this improvement is more evident, however, when this index is compared with its value for Jan. 1, which was 142. The Department of Labor "all commodity" index was 150 for June, 1922, as compared with 138 for January. Since the first of the year the index for metals and metal products has increased from 112 to 120, while chemicals and drugs have declined from 124 to 122.

This magazine's weighted index of chemical prices has fallen steadily during July. It averaged 155.61 for the month, as compared with 157.48 for June. The rise from 143.30 on Jan. 1, 1922, to 160.49 on May 24 was apparently too rapid to be of healthy significance and many important commodities have since receded from the temporary peak reached during May. This applies particularly to cottonseed and linseed oils, sulphuric acid, caustic soda, soda ash and barium chloride. Two factors which have contributed to lower prices during the past month are the freight rate reductions which took effect July 1 and the seasonal slackening of demand, which is usually associated with the summer months.

Situation in Individual Industries

Iron and Steel—The situation is reflected somewhat differently in the various chemically controlled industries. Reference has been made to the coal strike's effects on the iron and steel industries, which are already curtailing production. During the month of June, however, some increase was noted. The output of pig iron increased 2¼ per cent over May. The unfilled orders of the U. S. Steel Corporation on June 30 showed a considerable gain over the previous month, amounting to 5,635,531 tons on June 30, as against 5,254,228 tons on May 31.

Paper—Total newsprint production during June was 127,230 net tons, but in June, 1921, it amounted to only 86,770. This is equivalent to a gain of 47 per cent. The total for the first 6 months of 1922 is 690,142 tons, as compared with 615,448 tons for the corresponding half of last year. This production is the highest in 5 years, with the exception of 1920.

Automobile—The automobile industry continues to set production records. The June output of passenger cars was 261,963, as compared with 231,724 in May. The steady improvement in the production of trucks, from 23,803 in May to 25,916 in June, may be interpreted as a very favorable index of general business conditions. The month of July is expected to show some seasonal decrease in this industry, but it is estimated that the total yearly output of passenger cars and trucks will be 2,000,000 for 1922, as against 1,668,000 in 1921 and 2,205,197 in the record year 1920.

Petroleum—The petroleum industry has ridden to a fall. May and June productions were but slightly below the record set last March in spite of the fact that consumption of all products except gasoline was unusally low and tremendous oil stocks were piling up. The result has been one price cut after another. Mid-Continent crude had a second cut last week of 25c., bringing it down to $1.50, while crude Pennsylvania oil is selling for $3 a barrel.

Construction—The building boom, which has been gathering momentum in the past 6 months, has resulted in more than doubling the volume of construction completed during the first half of last year. The paint and varnish, structural steel and glass industries have been favorably affected by the increased demand and slightly higher prices for construction materials. The cement industry, stimulated by the demands for both construction and highway programs, has been proceeding at capacity production.

Glycerine Prospects

In the July number of the *Buyers' Bulletin*, issued by Roger Babson's statistical organization, the following interesting comment is made on the glycerine situation:

"For many months the statistical position of glycerine has forced prices to a comparatively low basis. Since 1919 stocks have ruled abnormally large and general business conditions have failed to readjust the situation. Production this year is practically the highest on record and while consumption has also extended upward, an over-supply still exists.

"It will take some time, under present conditions, to reduce current stocks to a level that will justify a broad recovery in price. From an international standpoint the volume of imports is counteracted by exports. This does not mean that a further reaction in price is warranted. A recovery of 7 per cent has already taken place since the low of 1921. Still prices are 27 per cent under the 10-year average prior to 1913. We consider the abnormal situation about discounted by the present range of prices. The next broad movement, although it will not materialize in the immediate future, will be upward and not downward."

The Chemical Market During July

Chemical and allied products showed very few important price changes in the New York market during the past month, due perhaps to the seasonable dullness of the summer months. The railroad situation, the coal strike and tariff uncertainties have greatly retarded possible improvement in business. The export market in alkalis has been somewhat of a disappointment to leading factors, who were of the opinion that prices would be much higher than present levels. Financial difficulties in Germany and the fluctuating exchanges are said to be the direct causes for the declining market.

Sharp Cut in Formaldehyde a Feature

A feature of special interest was the sharp cut in the price of formaldehyde. During the month manufacturers, eager for passing business, quoted prices as low as 7¼c. per lb., the lowest level recorded since the war. During the latter part of July, however, producers were pressed for deliveries and prices were brought back to 8@8¼c. per lb. Prussiate of soda, barium chloride, caustic potash and potash alum have recorded slight decreases during the interval, due to increasing stocks and lack of interest from consumers. In contrast with these declines there was a significant advance in white powdered arsenic. Insecticide manufacturers have reported a phenomenal demand and spot material has become very scarce. Prices were advanced from 7c. to 7¾c. per lb. Oxalic acid was another item that showed considerable strength during the month. Producers announced an advance at the works from 14c. to 14½c. per lb. early in the month and quotations have held very steady throughout the interval, with consumers buying in moderate quantities.

Calcium Acetate Prices Increased

Calcium acetate prices were increased on two occasions during July owing to the decreased spot supplies and the increasing demand. The first advance was from $1.75 to $2 per 100 lb. The following week another advance of 35c. per 100 lb. was announced, bringing the spot market to $2.35 per 100 lb. Acetone and all grades of acetic acid were advanced to correspond with the lime acetate market. Sulphate of ammonia, copper sulphate, acetate of soda and prussiate of potash have shown considerable strength, with fractional advances recorded among first hands.

It may be stated in general that the markets during July revealed few surprises to the professional trader. Nor is there any reason to believe that the coming months will bring about any disastrous results, but, on the contrary, producers are very optimistic about the fall season and are looking forward to a resumption of real business with the industries that consume chemicals and related materials.

The New York Market

NEW YORK, July 31, 1922.

The chemical market during the past week continued along the same quiet lines in evidence during the preceding week. Trading in most instances was for immediate consumption, with the general tone extremely conservative. There were a few important price changes, foremost among which was the decrease noted in caustic soda for export. Trading has shown a decided improvement since the last decline and leading producers are looking forward to a much firmer market in the near future. Oxalic acid was reported fractionally higher at the works. White powdered arsenic continued firm, with only odd lots available. Acetate of soda was decidedly strong and buyers found some difficulty in getting any round quantities. All grades of acetic acid recorded advances to correspond with the recent rise in calcium acetate. Copper sulphate continued very firm. Insecticide dealers have been in this market for large tonnages and no let-up is in sight for the next few weeks. Cyanide of potash has been very scarce of late and prices showed an advance from 50@55c. per lb. The spot market is very firm.

GENERAL AND SPECIAL CHEMICALS

Ammonium Sulphate—Restricted production has kept this item rather short on spot, with the demand much greater than the supply. It is doubtful if better than $3.55 per 100 lb. could be done for double bags, f.a.s. N. Y.

Arsenic — Leading factors quote the market very firm at 7½c. per lb., prompt shipment. There have been a few odd lot sales among second hands at 7¾@8c. per lb. The demand is brisk.

Acetic Acid—Higher prices for calcium acetate have caused an advance in all grades of this acid. The 28 per cent is quoted at $2.60 per 100 lb., with the 56 per cent at $5.25 per 100 lb. Glacial acetic is held around 11c. per lb. in barrel lots. Demand is moderate.

Acetone—Prices for acetone were advanced by makers in order to correspond to the increase on acetate of lime. Chemically pure acetone is selling at 13@13½c. per lb. for carlots, with smaller quantities at 14@15c. The general market is firm.

Bichromate of Soda — Some small transactions were recorded at 7c. per lb., with quantity lots down to 6¾c. Trading was only moderate with the call mostly for contract shipments.

Bicarbonate of Soda — Producers quote the market around $1.75 per 100 lb., in barrels. The general tone of the market is steady, considering the time of the season.

Caustic Soda — There was another decline in this product to $3.50 per 100 lb. f.a.s. The demand was much better from the Orient and various European centers. Contract prices are nominally unchanged.

Copper Sulphate — There was a healthy tone to this market, especially from the insecticide industry. Dealers quote 6½@6¾c. per lb. for limited quantities on spot.

Formaldehyde—Producers have withdrawn from the market and goods previously quoted down to 7½c. per lb. could not be located in any quarters. Second hands quote the spot market at 8@8½c. per lb. Demand is moderate.

Muriate of Potash — Following increased importations there has been a slight decrease in this item from $33.50 per ton to $33. There were some larger sales reported fractionally lower than this but the general range is from $33@$33.50 per ton.

Prussiate of Soda—Trading has been rather dull during the interval and prices ranged around 20½c. per lb. for spot goods. Shipments from abroad were quoted from 19½@20c. per lb. c.i.f., duty paid.

Oxalic Acid — Spot quotations were held at 15½@15½c. per lb. The best price heard at the works was 14½c. per lb. Demand is much better, with consumers showing more interest in spot goods.

WAXES

Beeswax—The market for African crude was rather steady both here and abroad. Offerings in several directions were limited, with spot quotations around 24@25c. per lb. Brazilian crude held at 28@29c. per lb.

Candelilla Wax—There were only a few offerings on spot at 40c. per lb. The demand far exceeds the limited supply.

Carnauba Wax—Prices in all grades have undergone little change. Shipments have increased notably of late, but prices were somewhat steady during the week. No. 3 North Country held at 16½@17c. per lb. No. 2 was quoted at 22@24c. per lb.

Japan Wax — The market did not show any signs of live trading and prices remained unsteady at 16½@17c. per lb. Forward business was transacted at 15c. per lb., in large lots.

Montan Wax—Prices were not very strong in this item. Spot material is in liberal supply with competition very keen. The market closed at 3¾@4c. per lb.

Paraffine Wax—There was little demand during the past week, but prices remained steady. Crude scale of 122-124 deg. melting point was held at 2½@2¾c. per lb., for carload quantities.

The Chicago Market

CHICAGO, July 25, 1922.

There was a little more life to the chemical market during the past week and buyers appeared to be interested in larger quantities. The rail strike probably had considerable to do with this, as supplies from the East were coming in slower than usual. The tone of the market is firm, with only a very few declines to be noted. Higher prices in the spot market were predicted unless there is an early settlement of the coal and rail strikes. Imported material is as firm as domestic in this market and no heavy stocks of either could be located.

GENERAL CHEMICALS

Caustic soda was a trifle easier on spot and supplies were available at $3.80 per 100 lb. for the 76 per cent solid and $4.35 for the ground. *Caustic potash* was firmer, with most holders asking 6¾@6¾c. per lb. for the imported 88-92 per cent material. *Soda ash* was unchanged at $2.20@$2.30 per 100 lb. for the 58 per cent material in cooperage.

Alums were unchanged both as to price and demand. *Ammonia alum* was available in second hands at 3¾@4¼c. per lb. for the lump and 4½@4¾c. for the ground. *Potash alum* moved in a fair volume at 4½@5c. per lb. for the iron-free lump and 5½@6c. for the U.S.P. powdered. *Sal ammoniac* was quiet, with open quotations unchanged at 7¾@8c. per lb. for the white granular. It is possible that the lower figure could have been shaded fractionally with a fair-sized inquiry. *Copper sulphate* displayed no signs of weakness, and quotations were firm at 6½@7c. per lb. *Carbon bisulphide* was in good demand and supplies were more plentiful at 7@7½c. per lb. *Carbon tetrachloride* was reported as moving in a fair way at 10@10½c. per lb. for the large drums. *Formaldehyde* was somewhat more active, although the price was unchanged at 9c. per lb. for single-barrel lots. *Glycerine* was firmer and refiners were asking 16c. per lb. for the c.p. material in large drums. *Red phosphorus* was available at slightly lower prices from second hands, who apparently had all the business at 25@26c. per lb. for single-case lots.

No improvement was to be noted in *bichromates*. *Potasium bichromate* was quoted at 11c. per lb. in single-cask lots and *sodium bichromate* at 8½@9c. in similar quantities. *Red prussiate of potash* continued exceedingly scarce, with only small lots available at 90c.@$1 per lb. The yellow salt was in about the same position as before and was offered at 32@35c. per lb. *Potash permanganate* lacked quotable change and the U.S.P. small crystals were available at 15½@16c. per lb. *Hypo* was reported to be moving in the usual consuming channels at $3.85 per 100 lb. for the pea crystals in barrels.

LINSEED OIL

The movement of *linseed oil* was rather slow during the past few days and the market was reported as weaker. The boiled oil was quoted late today at 95c. per gal. in 5-drum lots, with similar lots of the raw at 93c.

NAVAL STORES

Turpentine, like linseed oil, has been moving only in a small volume during the past few days, with the tendency of the market downward. Five-drum lots were quoted today at $1.22½ per gal. *Rosin* was in better demand and the WG grade was offered in less than carlots at $8.75 per 280 lb.

The Iron and Steel Market

PITTSBURGH, July 28, 1922.

The combination of the railroad strike begun 4 weeks ago and the coal strike begun 4 months ago is the dominant factor not only in the iron and steel trade but in industry generally. Coal supplies, which increased during the first 3 months of the coal strike, have decreased sharply since transportation difficulties arose.

It is now much more than a matter of whether pig iron and steel can be produced. It is a question also of whether the pig iron and steel can be consumed. Thus far there is little if any indication that industrial operations have been slowed down at any point through lack of steel, but it seems altogether probable that there will be a slowing down in steel consumption, through insufficiency of transportation and of coal supply.

STEEL INGOT PRODUCTION

Steel ingot production reached its maximum rate toward the close of June, having increased rapidly in the first 3 months of the year and slowly thereafter. There has since been a decrease, and by this time the decrease may amount to between 5 and 10 per cent. The influence of diminished coal supply is felt first at byproduct coke ovens, rather than in coal for heating and rolling steel. Some byproduct ovens were running on a hand-to-mouth basis, others had small stocks, none probably sufficient for 30 days' operation. The banking and blowing out of blast furnaces comes more promptly at some points than at others, being especially noticed in eastern Pennsylvania and in the Mahoning and Shenango Valleys. Unless conditions change promptly and radically for the better many more furnaces will have to stop.

The effect of the new situation upon the steel market has been for buyers and sellers to cease considering late deliveries at all, and to increase the pressure to buy small lots for early shipment, as a result of which delivery premiums have increased in some cases. Basis prices, for extended delivery, are not greatly affected, except that mills are somewhat stiffer in their views, finding that with restricted production the tonnage they had on books will keep them occupied a longer time than they estimated a month ago. The minimum price on bars, shapes and plates is now 1.70c. instead of 1.60c., this being for indefinite delivery, on orders that prove attractive to mills. Former prices of 2.40c. on blue annealed sheets, 3.15c. on black, and 4.15c. on galvanized sheets are not entirely lost, but it is very difficult to make purchases except at $2@$3 a ton higher.

Offerings of Connellsville coke are lighter and prices are higher, being quotable at $13.50@$14 for furnace coke and at $14.50@$15 for foundry coke. Blast furnaces disappeared from the market long ago, and most other consumers, except foundries, have since disappeared, while foundries are buying but little in proportion to their normal requirements. As a matter of fact, the quotations on the respective grades may be taken to mean that coke offered as "foundry" grade is more or less of that grade, while coke sold as "furnace" coke is for foundry use, but is not at all guaranteed as to grade.

Connellsville steam coal has sold up to $8.50 and Westmoreland County gas coal up to $9.50, but how much of the coal recently bought and sold will get through, now that the priority system is established on the railroads, is a question.

PIG IRON PRICES

Production of merchant pig iron has dwindled to almost insignificant proportions, as has inquiry. Any forced purchases would no doubt cause sharp advances in market prices, but consumers seem indisposed to bid for the limited quantities of pig iron in existence or likely to be made in the next few weeks. On the basis of last sales the market is quotable at $25 for bessemer, $24 for basic, $27 for malleable and $25 for foundry, f.o.b. valley furnaces, but these prices are largely nominal, it being uncertain whether any business could be done at such prices.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0.38 – $0.40
Acetone	lb.	$0.13½ – $0.13¾	.14 – .14½
Acid, acetic, 28 per cent	100 lbs.	2.60 – 2.65	2.70 – 3.25
Acetic, 56 per cent	100 lbs.	5.25 – 5.35	5.40 – 5.75
Acetic, glacial, 99½ per cent, carboys, 100 lbs.		11.00 – 11.25	11.30 – 11.50
Boric, crystals	lb.	.11 – .11½	.11½ – .12
Boric, powder	lb.	.11 – .11½	.11½ – .12½
Citric	lb.	..... –	44½ – .45
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11 – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – .04½	.04½ – .05
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg	lb.	.06 – .06½	.06½ – .07
Nitric, 42 deg	lb.	.06½ – .06¾	.07 – .07½
Oxalic, crystals	lb.	.15½ – .15¾	.15½ – .16
Phosphoric, 50 per cent solution	lb.	.08 – .08¼	.08½ – .09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.50 – 10.00	..... – .....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15.00 – 16.00	..... – .....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.28½ – .29
Tartaric acid, imported, powdered	lb.	..... –	.29 – .30
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1.00 – 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.31 – .33
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.31 – .33
Alum, ammonia, lump	lb.	.03¾ – .03¾	.03¾ – .04
Alum, potash, lump	lb.	.03 – .03¼	.03¼ – .04
Alum, chrome lump	lb.	.05 – .05¼	.05¼ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06½ – .07½	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08½	.08½ – .09
Ammonium nitrate	lb.	.06 – .06½	.06½ – .07½
Amylacetate tech	gal.	..... –	2.00 – 2.25
Arsenic, white, powdered	lb.	.07½ – .08	.08½ – .08½
Arsenic, red, powdered	lb.	.12 – .12½	.12½ – .13
Barium carbonate	ton	61.00 – 63.00	64.00 – 68.00
Barium chloride	ton	90.00 – 93.00	94.00 – 105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	1.60 – 1.75	1.85 – 2.50
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05¼ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.35 – 2.40	2.45 – 2.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.80 – .83
Carbon bisulphide	lb.	.06½ – .06¾	.07 – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½ – .04¾	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05¼	.05½ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2.10
Copperas	ton	20.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.19 – .20	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.50 – 6.60	6.65 – 7.00
Cream of tartar	lb.	..... –	.23 – .25
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.60 – .65
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.08 – .08¾	.08½ – .09
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	..... – .....
Fullers earth—imported powdered—net	ton	30.00 – 32.00	..... – .....
Fusel oil, ref	gal.	..... –	2.25 – 2.65
Fusel oil, crude	gal.	..... –	1.45 – 1.50
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	15½ – 15¾
Iodine, resublimed	lb.	..... –	4.20 – 4.25
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate	lb.	..... –	.09½ – .11½
Lead arsenate, powd	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½ – .07½
Magnesium sulphate, U. S. P.	100 lb.	2.00 – 2.25	2.30 – 2.50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1.80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	.11 – .11½

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Phogene (see carbonyl chloride)			
Phosphorus, red	lb.		.40 – .45
Phosphorus, yellow	lb.		.30 – .35
Potassium bichromate	lb.	.09½ – .09¾	.10 – .10½
Potassium bromide, granular	lb.		.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05½	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07½ – .08
Potassium cyanide	lb.		.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	5.50 – 5.75	6.00 – 6.25
Potassium iodide	lb.		3.20 – 3.35
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.14 – .14¼	.14½ – .15
Potassium prussiate, red	lb.		.90 – .95
Potassium prussiate, yellow	lb.	.31½ – .32	.32½ – .32½
Rochelle salts (see sodium potas. tartrate)			
Salammoniac, white, granular	lb.	.06½ – .07	.07½ – .08
Salammoniac, gray, granular	lb.	.07½ – .08	.08½ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	19.00 –22.00	
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.06½ – .06¾	.07 – .07½
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.06½ – .07	.07½ – .07½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04½	.04½ – .05½
Sodium chlorate	lb.	.06½ – .06½	.07 – .07½
Sodium chloride	long ton	12.00 –13.00	
Sodium cyanide	lb.	.21 – .22	.22½ – .25
Sodium fluoride	lb.	.09½ – .10	.10½ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.50 – 3.55	3.60 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .03	.03½ – .03½
Sodium nitrite	lb.	.08 – .08½	.08½ – .09
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04½ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.		.18 – .21
Sodium prussiate, yellow	lb.	.20½ – .21	.21½ – .21½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04½ – .04¾	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03¾	.03¾ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 –20.00	
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.		2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 –40.00	
Talc—domestic powdered	ton	18.00 –25.00	
Tin bichloride	lb.	.09 – .09½	.09½ – .10
Tin oxide	lb.		.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14½ – .15½
Zinc chloride, gran.	lb.	.06 – .06½	.06½ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08½ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.14 — .16
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.30
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.63 — .67
Benzoate of soda, U.S.P.	lb.	.53 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .26
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbasol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97-99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.33 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.55 — .58
H-acid	lb.	.85 — .95
Meta-phenylenediamine	lb.	.85 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06¼
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobensene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	$0.15 — $0.17
N-W acid	lb.	1.15 — 1.30
Ortho-amidophenol	lb.	2.15 — 2.25
Ortho-dichlor-benzene	lb.	2.15 — .20
Ortho-nitro-phenol	lb.	.70 — .75
Ortho-nitro-toluene	lb.	.10 — .13
Ortho-toluidine	lb.	.14 — .18
Para-amidophenol, base	lb.	1.30 — 1.35
Para-amidophenol, HCl	lb.	1.35 — 1.40
Para-dichlorbenzene	lb.	.17 — .20
Paranitroaniline	lb.	.72 — .80
Para-nitrotoluene	lb.	.55 — .65
Para-phenylenediamine	lb.	1.55 — 1.60
Para-toluidine	lb.	.90 — 1.00
Phthalic anhydride	lb.	.35 — .38
Phenol, U. S. P., drums	lb.	.15 — .15½
Pyridine	gal.	1.75 — 2.75
Resorcinol, technical	lb.	1.30 — 1.35
Resorcinol, pure	lb.	1.75 — 1.80
R-salt	lb.	.60 — .70
Salicylic acid, tech., in bbls.	lb.	.23 — .24
Salicylic acid, U. S. P.	lb.	.25 — .26
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.27 — .32
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14 — .18
Sulphanilic acid, crude	lb.	.24 — .26
Tolidine	lb.	1.20 — 1.30
Toluidine, mixed	lb.	.30 — .35
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.30 — .35
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 —
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 —

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.20 — $0.21
Beeswax, refined, dark	lb.	.30 — .32
Beeswax, refined, light	lb.	.34 — .35
Beeswax, pure white	lb.	.38 — .42
Candellila, wax	lb.	.40 — .42
Carnauba, No. 1	lb.	.40 — .42
Carnauba No. 2, North Country	lb.	.22 — .24
Carnauba, No. 3, North Country	lb.	.16½ — .16½
Japan	lb.	.16½ — .17
Montan, crude	lb.	.03½ — .04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04½ —
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ —
Paraffine waxes, refined, 118-120 m.p.	lb.	.03½ — .03½
Paraffine waxes, refined, 125 m.p.	lb.	.03½ — .03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 — .04½
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ — .04½
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 — .05½
Stearic acid, single pressed	lb.	.09 — .09½
Stearic acid, double pressed	lb.	.09½ — .09½
Stearic acid, triple pressed	lb.	.10½ — .10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$5.65 —	$6.10
Rosin E-I	280 lb.	6.10 —	6.55
Rosin K-N	280 lb.	6.65 —	7.75
Rosin W. G.-W. W.	280 lb.	7.85 —	8.40
Wood rosin, bbl.	280 lb.	6.25 —	
Spirits of turpentine	gal.	1.22 —	1.23
Wood turpentine, steam dist.	gal.	.85 —	
Wood turpentine, dest. dist.	gal.	.70 —	.70
Pine tar pitch, bbl.	200 lb.	—	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	—	9.50
Retort tar, bbl.	500 lb.	—	9.00
Rosin oil, first run	gal.	.36 —	
Rosin oil, second run	gal.	.38 —	
Rosin oil, third run	gal.	.46 —	
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist.	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref.	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55 —	3.60
Blood, dried, f.o.b., N. Y.	unit	4.50 —	
Bone, 3 and 50, ground, raw	ton	37.00 —	39.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.55 —	2.60
Tankage, high grade, f.o.b. Chicago	unit	3.50 —	3.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	33.00 —	33.50
Potassium sulphate	unit	1.00 —	

Crude Rubber

Para—Upriver fine	lb.	$0.19 —	.19¼
Upriver coarse	lb.	.13½ —	.13½
Upriver caucho ball	lb.	.13½ —	.13½
Plantation—First latex crepe	lb.	.14½ —	.15
Ribbed smoked sheets	lb.	.14½ —	.15
Brown crepe, thin, clean	lb.	.13½ —	
Amber crepe No. 1	lb.	.14 —	

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.11	—	$0.11½
Castor oil, AA, in bbls	lb.	.12	—	.12½
China wood oil, in bbls	lb.	.12½	—	.12½
Coconut oil, Ceylon grade, in bbls	lb.	.08½	—	.08½
Coconut oil, Cochin grade, in bbls	lb.	.09	—	.09½
Corn oil, crude, in bbls	lb.	.11	—	.11½
Cottonseed oil, crude (f. o. b. mill)	lb.	.09	—	.09½
Cottonseed oil, summer yellow	lb.	.11	—	.11½
Cottonseed oil, winter yellow	lb.	.12	—	.12½
Linseed oil, raw, car lots (domestic)	gal.	.89	—	.90
Linseed oil, raw, tank cars (domestic)	gal.	.84	—	.85
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.92	—	.93
Olive oil, denatured	gal.	1.15	—	1.17
Palm, Lagos	lb.	.07	—	.07½
Palm, Niger	lb.	.06½	—	.06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09½	—	.09½
Peanut oil, refined, in bbls	lb.	.12½	—	.12½
Rapeseed oil, refined in bbls	gal.	.82	—	.83
Rapeseed oil, blown, in bbls	gal.	.88	—	.89
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½	—	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09½	—	....

FISH

Light pressed menhaden	gal.	$0.51	—	....
Yellow bleached menhaden	gal.	.53	—	.54
White bleached menhaden	gal.	.55	—	.56
Blown menhaden	gal.	.61	—	....
Whale Oil, No. 1, crude, tanks, coast	gal.	.45	—	.48

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$700.00		$750.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	75.00	—	110.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	14.00	—	17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00	—	23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00	—	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00	—	24.00
Barytes, crude f.o.b. mines	net ton	8.00	—	9.00
Casein	lb.	.10½	—	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00	—	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00	—	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00	—	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	—	12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	13.00	—	20.00
China clay (kaolin), imported, lump	net ton	16.00	—	20.00
China clay (kaolin), imported, powdered	net ton	30.00	—	35.00
Feldspar, No. 1 pottery grade	long ton	6.50	—	6.75
Feldspar, No. 2 pottery grade	long ton	5.75	—	5.90
Feldspar, No. 1 soap grade	long ton	7.00	—	7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00	—	22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05	—	.05½
Graphite, Ceylon chip	lb.	.04	—	.04½
Graphite, high grade amorphous crude	ton	35.00	—	50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00	—	....
Kieselguhr, f.o.b. N. Y	per ton	50.00	—	55.00
Magnesite, calcined (powdered)	per ton	8.00	—	12.00
Pumice stone, imported	lb.	.03	—	.05
Pumice stone, domestic, lump	lb.	.05	—	.05½
Pumice stone, domestic, ground	lb.	.06	—	.07
Shellac, orange fine	lb.	.78	—	.79
Shellac, orange superfine	lb.	.80	—	.81
Shellac, A. C. garnet	lb.	.66	—	.67
Shellac, T. N.	lb.	.75	—	.76
Silica, glass sand, f.o.b. Indiana	per ton	1.50	—	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50	—	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00	—	16.00
Silica, building sand, f.o.b. Pa	per ton	2.00	—	2.75
Soapstone	ton	12.00	—	15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00	—	12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50	—	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	16.00	—	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per 1,000	$130.00
Chrome brick, f.o.b. Eastern shipping points	net ton	40–42
Chrome cement, 40-50% Cr_2O_3	net ton	24–32
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	28–35
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	26–28
Magnesite brick, 9-in. straight (f.o.b. works)	net ton	56
Magnesite brick, 9-in. arches, wedges and keys	net ton	70
Magnesite brick, soaps and splits	net ton	90
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	33–35
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	35–40
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	31–33
Silicon carbide refractory brick, 9-in	1,000	1100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00	—	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10	—	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½	—	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	67.50	—	69.00
Ferromanganese, 78-82% Mn, German	gross ton	67.00	—	67.50
Spiegeleisen, 19-21% Mn	gross ton	36.00	—	....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00	—	2.25
Ferrosilicon, 10-15%	gross ton	38.00	—	40.00
Ferrosilicon, 50%	gross ton	58.00	—	60.00
Ferrosilicon 75%	gross ton	115.00	—	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.42½	—	.45
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00	—	....
Ferrovanadium, 30-40% per lb. of contained V	lb.	3.50	—	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried	net ton	$6.00	—	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	19.00	—	21.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	18.00	—	21.00
Coke, foundry, f.o.b. ovens	net ton	13.50	—	....
Coke, furnace, f.o.b. ovens	net ton	13.00	—	....
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00	—	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50	—	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½	—	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.29½	—	.30
Manganese ore, chemical (MnO_2)	net ton	60.00	—	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y	lb.	.50	—	....
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00	—	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½	—	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12	—	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal		
Rutile, 95% TiO_2 per lb. ore	lb.	.12	—	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	3.00	—	3.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	3.25	—	3.50
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25	—	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25	—	2.50
Vanadium pentoxide, 99%	lb.	12.00	—	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00	—	....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½	—	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13.875–14.00
Aluminum, 98 to 99 per cent	18.00–19.00
Antimony, wholesale lots, Chinese and Japanese	5.25
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–34.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	32.50
Lead, New York, spot	5.75
Lead, E. St. Louis, spot	5.375–5.40
Zinc, spot, New York	6.25 – 6.30
Zinc, spot, E. St. Louis	5.925

OTHER METALS

Silver (commercial)	oz.	$0.69½
Cadmium	lb.	1.20–1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.10
Platinum	oz.	90.00
Iridium	oz.	170.00@175.00
Palladium	oz.	55.00@ 60.00
Mercury	75 lb.	55.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	30.25
Copper bottoms	27.75
Copper rods	19.25
High brass wire	16.75
High brass rods	14.25
Low brass wire	18.25
Low brass rods	18.75
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	20.75
Seamless high brass tubing	18.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	10.25@10.50
Copper, heavy and wire	10.00@10.25
Copper, light and bottoms	7.75@ 8.25
Lead, heavy	3.90@ 4.15
Lead, tea	2½–2¾
Brass, heavy	4.50@ 4.75
Brass, light	4.00@ 4.25
No. 1 yellow brass turnings	4.00@ 4.25
Zinc	2.00@ 2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.70	$2.70
Soft steel bars	2.60	2.60
Soft steel bar shapes	2.60	2.60
Soft steel bands	3.10	3.20
Plates, ¼ to 1 in. thick	2.70	2.70

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

LEATHER—The Charles S. Walton Co., Philadelphia, Pa., tanner of sole and belting leathers, has placed its tannery at Curtis Bay, Baltimore, Md., on a full capacity basis, with regular working force.

The General Leather Co., Frelinghuysen Ave., Newark, N. J., specializing in automobile leathers, is developing maximum capacity at its plant. The company has recently placed its new addition in service, giving the plant a capacity of 1,200 salted hides per day.

The Greiss-Pfleger Tanning Co., Cincinnati, O., has increased production at its tanneries at Chicago and Waukegan, Ill. The June shipments from the plants were the largest in the history of the company.

A number of leather tanneries at Newark, N. J., are advancing operations to a close to normal basis, including Straus & Sons, and the Good Brothers Leather Co. Imitation leather companies in this section also are working on an advanced production schedule.

CERAMIC—The Conkling-Armstrong Terra Cotta Co., Philadelphia, Pa., has adopted a capacity operating basis at its plant, and a number of departments are now running on an overtime schedule.

The National Fireproofing Co. is maintaining active production at its plant at Port Murray, N. J., giving employment to a large working force.

IRON AND STEEL—The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., has resumed operations at another blast furnace, making a nine-furnace base for the company, six producing basic iron, two running on foundry pig, and one on ferromanganese.

The Eastern Steel Co., Pottsville, Pa., has blown in two blast furnaces at its local plant, following an idle period of many months. Every department of the works is now in service, and operations will be increased in different branches at an early date.

The United States Steel Corp., New York, has advanced production at its different mills to a 76 per cent of normal operating basis.

The Carnegie Steel Co. is operating its six blast furnaces at Youngstown, Ohio, at full capacity on large merchant bar.

The coal strike and railroad strike have caused the suspension of a number of blast furnaces, heretofore running at capacity up to about a week ago. These include two bessemer furnaces of the Republic Steel Co. and one furnace of the Trumbull-Cliffs Iron Co., both in the Youngstown, O., district. The Briar Hill Steel Co., in the same section, has banked one of its furnaces. The Bethlehem Steel Co. has placed three of its furnaces out of blast, two being at the Bethlehem, Pa., works, and the other at Steelton, Pa. At Cleveland, O., the McKinney Steel Co. has banked one of its furnaces.

The Youngstown Sheet & Tube Co., Youngstown, O., is now running at close to 80 per cent of normal.

METALS—The Cerro de Pasco Copper Corp., New York, will soon place its new smelting plant at Oraya, Peru, in operation. The plant will run on a basis of 2,500 tons of ore per day, the ore being estimated to average from 5 to 6 per cent of copper.

The Bartlesville Zinc Co., Bartlesville, Okla., is increasing production at its plant at Blackwell, Okla. The wages of employees have been advanced 50 cents a day, making an increase of over one dollar a day since the company reopened its plant a few months ago.

The Calumet & Hecla Copper Co., Calumet, Mich., is operating on a production basis of about 4,000,000 lb., refined, per month; of this amount, about 1,500,000 lb. is being secured from the reclamation plant.

PAPER—The United Paper Board Co., Lockport, N. Y., is running on a capacity basis at its local mill. A general increase of 10 per cent has been made in wage schedules.

The International Paper Co. has increased operations to four machines at its plant at Three Rivers, Que., with output totaling 240 tons per day.

MISCELLANEOUS—The United States Guano Co., Standard Wholesale Phosphate Co., Union Acid Works, Standard Guano Co. and the Standard Acid Works, all of Baltimore, Md., and operated under one management, manufacturing fertilizer products, are increasing production at their plants. Extensions are under way to utilize the escaping gases for chemical reclamation.

The Chattanooga Coke & Gas Co., Chattanooga, Tenn., is arranging for the early resumption of operations at a portion of its plant.

Tire production at Akron, O., is now running close to 105,000 tires a day at all plants combined, which are giving employment to about 50,000 men and women.

The Midwest Castings Co., Middletown, O., is arranging for the immediate resumption of operations, following a shut-down for close to a year past.

Owing to fuel shortage, the American Sheet & Tin Plate Co., Youngstown, O., has closed 26 mills at its Farrell, Pa., works. The suspension is temporary.

The Three Rivers Glass Co., Three Rivers, Tex., will soon commence production at its new local plant. The building has been completed and machinery installation is under way. H. S. Warwick is manager.

The Whitall-Tatem Co., Millville, N. J., has placed two of its glass factories out of blast, and will commence immediate repairs to the furnaces and other plant departments. Resumption is planned early in the fall.

Construction and Operation

Arkansas

VAN BUREN—J. H. Hansel, Ozark, Ark., is organizing a company to establish a local plant for the manufacture of brick and other burned clay products. A site is being selected.

California

MARTINEZ—The Shell Oil Co., 343 Sansom St., San Francisco, has plans under way for the installation of a new still and other equipment at its local refinery, estimated to cost about $150,000.

OAKLAND—The Fornercrete Aggregate Co., manufacturer of cement specialties, colors, etc., for exterior construction, has leased property on Clement St., near High St., totaling about 30,000 sq.ft., as a site for the erection of a new plant. Plans will be prepared at once. E. K. Forner is president. The Industrial Department of the local Chamber of Commerce is interested in the project.

LOS ANGELES—The Pacific Coast Borax Co., Kohl Bldg., San Francisco, has acquired a tract of property in the harbor section, formerly occupied by the Chandler Shipbuilding Co., totaling about 10 acres of land, as a site for the erection of a new refining plant. It is estimated to cost close to $1,000,000, including machinery, and will handle the deposits from the company's property in Death Valley, Cal.

SACRAMENTO—The Pacific Gas & Electric Co., 445 Sutter St., San Francisco, will make extensions and improvements in its local artifical gas plant to cost about $150,000, including equipment.

IRVINGTON—The Panama Soap Co., San Diego, is negotiating with the city trustees for a suitable site for the erection of a new local plant for the manufacture of soaps and kindred products. It is proposed to remove the present works from San Diego, and discontinue operations entirely at this latter location.

SAN DIEGO—The Vitrified Products Corp. has purchased property in the Oldtown district, and plans for the erection of a new plant for the manufacture of shale brick. The equipment installation will provide for automatic operation, without handling after production has been commenced.

SANTA CLARA—The Concrete Lumber Co. is negotiating with the local Chamber of Commerce for a suitable site for the erection of a new plant. The company is now located at Los Angeles.

Colorado

TELLURIDE—The Tomboy Mine & Milling Co. has tentative plans under consideration for the rebuilding of the portion of its plant destroyed by fire, July 8, with loss estimated at about $50,000, including equipment.

Connecticut

MERIDEN—The Tredennick Paint Co., South Colony St., has commenced the erection of a new 1-story plant addition.

Illinois

JOLIET—The Illinois Wall Paper Co., a subsidiary of the York Card & Paper Co., York, Pa., is completing plans and will soon take bids for the erection of a new 1-story plant on Logan St., 100x300 ft., estimated to cost about $85,000. R. G. Hoen, 417 National Bank Bldg., Joliet, is architect. Robert D. McCoy is president.

Indiana

INDIANAPOLIS—The Beveridge Paper Co., Pearl St., has plans under way for the erection of a new building at its local plant. H. L. Beveridge is president.

JEFFERSONVILLE—The Louisville Cement Co., Louisville, Ky., has tentative plans under consideration for the rebuilding of the portion of its manufacturing plant at Speeds, near Jeffersonville, destroyed by fire, July 13, with loss estimated in excess of $300,000, including equipment.

Louisiana

NEW ORLEANS—The Chalmette Petroleum Corp., recently organized, has acquired the plant and property of the Chalmette Oil Refining Co. and the Louisiana Oil Exporting Co., and will consolidate the interests. Plans are under way for extensions in the oil refining plant for considerable increase in capacity. The new company will operate with a capital of $1,000,000.

LAFAYETTE—The Guidry Brick Co. is planning for extensions to double, approximately, the present plant capacity. A. Guidry heads the company.

Maryland

BALTIMORE—The United States Asphalt Refining Co., has filed plans for the erection of a 1-story building, 33x70 ft., at North and 4th Aves.

Massachusetts

AMHERST—The Amherst Agricultural College has awarded a contract to George S. Allen, Amherst, for the erection of its proposed new 3-story and basement chemical laboratory, 94x195 ft., estimated to cost about $300,000, including equipment. Ritchie, Parsons & Taylor, 15 Ashburton Place, Boston, are architects.

Michigan

DETROIT—Porath Brothers are considering preliminary plans for the rebuilding of the portion of their brick and clay products manufacturing plant, destroyed by fire, July 9, with loss approximately $50,000, including equipment.

MOUNT PLEASANT—The National Portland Cement Co. has excavation work under way for the initial buildings at its new plant at Coldwater Lake, and will commence foundations and superstructure at an early date. The main mill will be 2-story, and will be supplemented with a number of other buildings, including power plant, etc. The entire plant will cost about $500,000, including machinery. A. E. Gorham, 119 South Normal St., Mount Pleasant, is president.

Mississippi

HATTIESBURG—The Hattiesburg Pine Oils Co., recently organized with a capital of $425,000, has plans under way for the erection of a new plant on local site for the manufacture of pine oil, turpentine and kindred products. The mill is estimated to cost in excess of $75,000, with machinery. The company is headed by M. D. King and Paul S. West, both of Hattiesburg.

Missouri

ELVINS—The St. Louis Smelting & Refining Co., 722 Chestnut St., St. Louis, has

plans completed for the establishment of a local plant, in connection with extensive property developments on a tract of 650 acres. The project is estimated to cost close to $500,000, including machinery.

ST. LOUIS—Benjamin Moore & Co., Inc., manufacturer of paints, varnishes, etc., is reported to be planning for the immediate rebuilding of the portion of its plant on South Second Street, destroyed by fire, July 8. A number of plant buildings and equipment were damaged. An official estimate of loss has not been announced.

KANSAS CITY—The Acme White Lead Co., Detroit, Mich., will commence work at once on remodeling and improving its local plant building at 15th and Grand Sts. The Bliss Building Co., 402 Mutual Bldg., Kansas City, has the construction contract.

New Jersey

ELIZABETH—The Atlantic Tar & Chemical Works, Ltd., Rayway, Elizabeth, manufacturer of coal tar products and other chemical specialties, has plans in progress for enlargements in its plant for considerable increase in capacity. Additional equipment will be installed. To carry out the expansion, the company has arranged for a bond issue of $500,000, the larger part of the proceeds to be used for such purpose. George C Lewis is president, and David Wiener, vice-president and general manager.

NEWARK—Walter G. Jacobs, 9 Campbell St., operating a foundry for the manufacture of iron and other metal castings, has commenced the erection of a new 3-story plant at 63-73 Warren St., estimated to cost in excess of $75,000. Contract for the building has been let to the American Concrete Steel Co., Essex Bldg.

BLOOMFIELD—The Standard Oil Co. of New Jersey, 31 Clinton St., Newark, has filed plans for the construction of a new distributing plant and substation in the Silver Lake district, estimated to cost about $42,000.

PERTH AMBOY—The American Smelting & Refining Co., 120 Broadway, New York, has work under way on improvements at its local copper-refining plant, and expects to have the unit ready for service early in October.

New Mexico

TUCUMCARI—The Pecos Co. is perfecting plans for the completion of its local oil refinery, and will proceed with the work at an early date. The construction has been held in abeyance for a number of months past. The plant will be placed in service immediately upon completion.

CARRIZOZO—The Helen Rae Mining Co., will make a number of improvements in the mill at its local gold mining properties. The plant has been closed temporarily for this purpose; the machinery will be repaired.

New York

GOWANDA—The Eastern Tanners' Glue Co., has plans under way for the erection of a new plant on Palmer St. Richard Wilhelm is president.

NEW YORK—The Nevada Consolidated Copper Co., 25 Broad St., will soon commence the rebuilding of the concentrating plant at its properties, recently destroyed by fire with loss approximating $1,500,000, including machinery. The plant had a capacity of about 12,000 tons, and the new unit is expected to be of like size. The smelting plant at the property was not damaged by the fire and will be continued in operation.

Oklahoma

TULSA—The Phillips Petroleum Co., Bartlesville, Okla., has plans under way for the erection of a new gasoline absorption plant on site selected at DeNoya, near Tulsa. The plant is estimated to cost about $400,000, including compressors, pumps and other operating machinery, and will be one of the largest plants of this character ever built.

OKLAHOMA CITY—The City Commission has approved plans as prepared for a new water-purification plant at the municipal waterworks, and expects to call for bids at an early date. The city engineer is in charge.

Oregon

WILLIAMINA—The Oregon Face Brick Co., 204 Henry Bldg., Portland, has acquired a brick manufacturing plant at Willamina, and will place the works in operation at once. A number of improvements will be made. Local clay deposits have also been purchased for raw material supply. Robert Shelley is president.

Pennsylvania

PHILADELPHIA—The Gilbert Spruance Co., 312 North 3rd St. manufacturer of paints, varnishes, etc., has awarded a contract to Harry Gill, Jr., 2515 Germantown Ave., for the erection of a 2-story factory addition, 70x138 ft., at Richmond and Tioga Sts., estimated to cost about $47,000.

McKEES ROCKS—The Chesebrough Mfg. Co., 17 State St., New York, a subsidiary of the Standard Oil Co., manufacturer of vaseline and byproducts, is completing plans for the first unit of its proposed new local plant, and will call for bids at an early date. It will be 2 and 3 story, and is estimated to cost close to $500,000, including machinery. Other plant units will be built at a later date. The company recently acquired a tract of about 14 acres of land near McKees Rocks for the works. The Hunting-Davis Co., Century Bldg., Pittsburgh, is architect and engineer.

PITTSBURGH—The Watson Paint & Glass Co., 101 Wood St., has purchased from E. A. Campbell the factory of the Eagle Paint & Varnish Co., Galveston Ave., recently acquired by the latter. It is planning to occupy the property for extensions in its present works.

PITTSBURGH—The Atlantic Refining Co., Butler and 56th Sts., is considering preliminary plans for extensions in its local refining plant. Headquarters of the company are at 3144 Passyunk Ave., Philadelphia.

LOCK HAVEN—The General Refractories Co., Oliver Bldg., Pittsburgh, has purchased the local plant and property of the Hayes Run Fire Brick Co., Orviston, near Lock Haven, and will continue operations at the plant as heretofore. The company will be merged with the parent organization, which also recently acquired the plant and property of the Pennsylvania Fire Brick Co., Beech Creek, Pa.

South Carolina

PAMPLICO—The Consumers' Oil Co., is reported to be planning for the rebuilding of the portion of its plant, recently destroyed by fire.

Texas

STAMFORD—The Rule-Jayton Cotton Oil Co., has acquired local property, totaling about 20 acres, for the erection of a new cotton oil mill. Plans for the structure are under way. It is estimated to cost close to $150,000, including equipment. The mill will have an initial capacity of about 125 tons per day.

CHILDRESS—The City Council will commence the immediate construction of the proposed new filtration plant at the municipal waterworks, estimated to cost about $30,000.

EL CAMPO—The plant and property of the El Campo Oil Mill Co., has been acquired by H. E. Wilson, Wharton, Tex., and associates. The new owners will organize a company to operate the plant, and will make a number of improvements in building and equipment. It is expected to have the mill in regular service at an early date.

BEAUMONT—A portion of the local distillate plant of the Magnolia Petroleum Co., including storage tanks, etc., was destroyed by fire, July 15, with loss estimated at about $1,500,000, including equipment and sock.

Washington

CAMAS—The Crown Wilmette Paper Co., is reported to be planning for the erection of an addition to its plant on adjoining property, recently acquired.

West Virginia

GRAFTON—George W. Bowers, Manningtton, W. Va., is perfecting plans for the organization of a new company and the establishment of a local plant for the manufacture of pottery products. A site will be secured at an early date.

Canada

ASBESTOS, QUE.—The Johns-Manville Co., Madison Avenue and 41st St., New York, manufacturer of asbestos products, has acquired property here and plans for the erection of a large Canadian branch plant. The proposed works will consist of a number of buildings, including power plant, etc. and will be equipped to give employment to about 300 persons. The plant is estimated to cost close to $1,000,000. The company has also purchased the mining properties of the Bennett-Martin Co., at Thetford Mines, Que., in the same vicinity, and will use as a source of raw material. It is expected to have the initial plant unit ready for operation early in 1922. T. F. Manville is president.

Capital Increases, Etc.

THE BUFFALO COLD DRAWN STEEL CO., INC., Buffalo, N. Y., has filed notice of increase in capital from $2,000,000 to $3,500,000.

THE KOENITZER TANNING CO., Saginaw, Mich., has filed notice of decrease in capital from $325,000 to $100,000.

THE BULLET PROOF & NON-SHATTERABLE GLASS CORP., recently organized under New York laws, has filed notice to operate in New Jersey for the manufacture of special glass products. The company is represented by Edward S. Bock, 45 South Spring St., Elizabeth, N. J.

THE BOSTON LEATHER & FINDING CO., Bridgeport, Conn., has filed notice of increase in capital from $20,000 to $50,000.

THE YORKTOWN OIL & MFG. CO., Yorktown, Tex., has filed notice of increase in capital from $50,000 to $100,000.

THE BARAGUA SUGAR CO., 25 Broad St., New York, N. Y., operating a sugar refinery in Camaguey Province, Cuba, is disposing of a bond issue of $4,500,000, a portion of the proceeds to be used for general expansion. Edwin F. Atkins is president of the Punta Alegre Sugar Co., the parent organization.

THE NITRO PRODUCTS CO., Saginaw, Mich., has filed notice of reduction in capital stock from $200,000 to $20,000.

THE CONSTANTIN REFINING CO., Tulsa, Okla., has arranged for a bond issue of $720,000, a portion of the proceeds to be used for general expansion.

THE MUTUAL OIL CO., Denver, Col., will increase its capital stock from $15,000,000 to $30,000,000, a portion of the proceeds to be used for expansion, including the purchase of additional oil properties and refineries.

THE NIAGARA FELT & PAPER CO., Little Falls, N. Y., has filed notice of increase in capital from $60,000 to $200,000.

THE ILLINOIS-KANSAS OIL & GAS CO., Tulsa, Okla., has filed notice of increase in capital from $500,000 to $1,000,000.

THE FIBERBILT SPECIALTIES, INC., 427 Broadway, New York, N. Y., has filed a petition in bankruptcy. Edward McDonald has been appointed receiver.

THE DETROIT EMERY WHEEL CO., Detroit, Mich., has filed notice of dissolution under state laws.

New Companies

THE SUNSET RUBBER CO., Everett, Wash., has been incorporated with a capital of $150,000, to manufacture rubber specialties. The incorporators are C. E. Powley and W. A. McCloud, both of Everett.

THE WOODBRIDGE PRODUCTS CO., 123 Main St., Woodbridge, N. J., has filed notice of organization to manufacture lubricants, soaps, etc. The company is headed by George M. Anderson and LeRoy F. Kendall.

THE R. T. CLARK OIL CORP., Natchez, Miss., has been incorporated with a capital of $2,000,000, to manufacture petroleum products. The incorporators are R. T. Clark, Natchez; L. S. McFadden and R. L. Cheshire, both of Monticello, Ark.

THE SHINGLE-GIBB LEATHER CO., Philadelphia, is being organized by Lester H. Shingle, Walton and Thomas B. Gibb, 503 Chestnut St., to manufacture leather products. Application for a state charter will be made at once. The last noted incorporator represents the company.

THE EASLEY OIL CO., Pittsburgh, Pa., is being organized by Edwin A. Easley, S. A. Doherty and F. B. Carraher to manufacture oil products. Application for a state charter will be made on July 24. The company is represented by James F. Coyle, 1513 Berger Bldg., Pittsburgh.

THE ASPHALT ROOFING PRODUCTS CO., care of the Colonial Charter Co., Ford Bldg., representative, has been incorporated under state laws with a capital of $25,000, to manufacture prepared roofing specialties.

THE MOUND CITY LINSEED OIL CO., St. Louis, Mo., has been incorporated with a capital of $5,000, to manufacture linseed oil products. The incorporators are W. H. Wilkins, G. S. Sturges and J. J. Rufile, all of St. Louis.

THE PETROLEUM CORP., Wichita Falls, Tex., has been incorporated with a capital of $75,000, to manufacture petroleum products. The incorporators are F. W. Fischer, S. I. Carter and D. E. Ducas, all of Wichita Falls.

THE ENAMELART FINISHING CO., New York, N. Y., has been incorporated with

a capital of $10,000, to operate an enameling works. The incorporators are F. E. Pearson, G. S. Nobles and L. J. Schneider, 116 West 90th St., New York.

THE BROWN CLAY PRODUCTS CO., Canton, Ohio, has been chartered under state laws to manufacture brick and other burned clay products. The incorporators are Ira E. Brown and O. E. Smith, both of Canton.

THE AETNA EXTERMINATORS, INC., 3407 North Halsted St., Chicago, Ill., has been chartered under state laws to manufacture chemical products, insect powders, etc. The incorporators are A. U. Forman, Hulda Almert and Andrew H. Almert.

THE GUY STEEL CASTINGS CO., West Hartford, Conn., has been incorporated with a capital of $50,000, to manufacture steel and other metal castings. The incorporators are George B. Kinghorn, Southington, Conn.; J. E. Sinnott, Hartford, Conn., and W. R. Bennett, 249 Fairfield Ave., Hartford. The last noted represents the company.

THE PEERLESS OIL CO., Mannington, W. Va., has been incorporated with a capital of $700,000, to manufacture petroleum products. The incorporators are Jesse Shimp, E. B. Koen, both of Mannington and James A. Meredith, Fairmont, W. Va.

THE DE COTIIS CHEMICAL & COLOR CO., Pittsburgh, Pa., is being organized by A. De Cotiis, Roy Rhea and C. Schoemer, to manufacture paints, colors, chemicals, etc. Application for a state charter will be made on August 8. The company is represented by Duff, Marshall & Davis, 408 Union Arcade Bldg., Pittsburgh.

THE HARVARD CHEMICAL CO., Boston, Mass., has filed notice of organization to manufacture chemicals and chemical byproducts. The company is headed by John J. Palladino, 22 Dartmouth St., Boston.

INTERNATIONAL INKS, INC., Trenton, N. J., care of the Corporation Bureau of New Jersey, 33 West State St., Trenton, representative, has been incorporated with a capital of $1,000,000, to manufacture inks of various kinds, colors, etc.

D. D. JOHNSON & CO., LTD., 138 South Schuyler Ave., Kankakee, Ill., has been incorporated with a capital of $50,000, to manufacture chemical fungicides and other chemical specialties. The incorporators are David D. Johnson, C. H. Rumley and Lee E. Horton.

THE SHOPE BRICK CO., South Bend, Ind., has been incorporated with a capital of $25,000, to manufacture brick and kindred products. The incorporators are George J. Hoffman, Clem C. Whiteman and Richard Johnson, all of South Bend.

THE INTERNATIONAL PETROLEUM PRODUCERS, INC., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with capital of $1,000,000, to manufacture petroleum products.

THE BUMET RUBBER CO., East Orange, N. J., care of the New Jersey Registration & Trust Co., 525 Main St., East Orange, has been incorporated under state laws with a capital of $50,000, to manufacture rubber products.

THE CRAGEN OIL & REFINING CO., 24 North Main St., East St. Louis, Ill., has been chartered under state laws to manufacture refined oil products. The incorporators are Edward L. Cragen, Daniel T. Garber and Joseph A. Troy, Jr., all of East St. Louis.

THE GARDAPLANT CHEMICAL CO., St. Joseph, Mo., has been incorporated with a capital of $30,000, to manufacture chemicals and chemical byproducts. The incorporators are Glen Snyder, Henry Lake and C. J. Griswold, all of St. Joseph.

THE HERBINE CHEMICAL CO., New York, N. Y., care of Lieberman & Siegel, 51 Chambers St., representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are N. M. Goldstein, S. Brown and M. Herbst.

THE NEW JERSEY LEATHER CLOTH CO., Newark, N. J., has been incorporated with a capital of $50,000, to manufacture imitation leather products. The incorporators are Jacob Wallman, L. M. and Fred Scherer, 132 Paris St., Newark.

THE SOUTHWESTERN PRODUCTS CO., St. Louis, Mo., has been incorporated with a capital of $25,000, to manufacture soaps and kindred products. The incorporators are C. B. Brockett, H. W. Jameson and O. M. Charleville, all of St. Louis.

THE FIBRE BOARD & CASE CO., 326 West Madison St., Chicago, Ill., has been incorporated with a capital of $20,000, to manufacture fiber products. The incorporators are Dale S. Johnson, Thomas W. Reilly and Eugene D. Billings.

THE FEATHERED PAINT CO., New York, N. Y., care of L. A. Jackson, 220 West 42nd St., representative, has been incorporated with a capital of $5,000, to manufacture paints, varnishes, etc. The incorporators are H. R. Epstein and A. P. Boyd.

THE LARRY-HINDS CO., 240 Poplar St., Memphis, Tenn., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are W. R. Larry, and M. F. Hinds.

THE HARTEL BRASS & NICKEL WORKS, 270 New York Ave., Union Hill, N. J., has filed notice of organization to manufacture brass, bronze, nickel and other metal products. The company is headed by Otto Hartel.

THE SUPERIOR CHEMICAL PRODUCTS CO., 303 West Chicago Ave., Chicago, Ill., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are Douglas G. and H. J. Logan, and Claude H. Pratt.

THE STERLING ELECTRIC STEEL CASTING CO., Falling Springs Ave., Centerville, Ill., has been chartered under state laws to manufacture steel and other metal castings. The incorporators are Claude L. Harrell and George F. Baker.

THE HAWTHORNE CHEMICAL CO., Hawthorne, N. J., care of George A. McCausland, Hawthorne, representative, has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are William Van Eerde and Jacob C. Bachman, both of Hawthorne.

THE PAYNTER CORP., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $300,000, to manufacture automobile tires and other rubber products.

Industrial Notes

The Pittsburgh Testing Laboratory, Pittsburgh, Pa., announces the appointment of Harry M. Wey, as manager of the Chicago district, with an office located at 1560 Monadnock Block.

The Pennsylvania Pump and Compressor Co., Easton, Pa., announces the recent opening of a district office at 105 West Monroe Street, Chicago, Ill. H. M. Montgomery is in charge.

Samuel P. Sadtler & Son, Inc., consulting and analytical chemists, Philadelphia, Pa., announce that on July 1, Dr. Elbert C. Lathrop severed his connection with the duPont Co. and joined the Sadtler organization as vice-president and treasurer. Dr. Lathrop, a graduate of Depauw University, Indiana, 1907, was for nine years connected with the laboratory of Soil Fertility Investigations of the Bureau of Plant Industry, U. S. Department of Agriculture, where he carried out some very important research on the organic matter of soils for which, incidentally, he was awarded the Longstreth Medal by the Franklin Institute of Philadelphia in 1912.

The Gasoline Recovery Corp. announces that its engineering and sales departments have opened offices at 402 Janet Building, Charleston, W. Va., in charge of E. M. Burdette, vice-president and C. L. Voress, general manager.

The California Master Products Corp., Los Angeles, Cal., producers of white bentonite, calcined magnesite, and other nonmetallic minerals, have just completed an addition to their plant to provide warehouse facilities and allow the installation of a new Raymond 5-roller mill of latest design. F. A. Kaufman is manager.

W. Woodward Williams has been appointed vice-president of the Titan Iron and Steel Co., mechanically puddled wrought iron, Newark, N. J. Mr. Williams graduated from Harvard University in 1905. After six years in the mills of the Carnegie Steel Co. at Pittsburgh, Duquesne and Youngstown, he entered the sales department of the Bowne-Fuller Co., Cleveland, and was later appointed manager of its Pittsburgh office. In January, 1914, he became general manager of sales of the A. M. Byers Co., Pittsburgh, and subsequently was made its general manager. In August, 1919, he became general manager of the Reading Iron Co., and afterward was elected vice-president, in charge of sales and operations. In September, 1920, he became associated with the Pittsburgh Gage & Supply Co., the largest jobber of wrought iron pipe in the United States, resigning the vice-presidency on May 31, 1922, and entering immediately upon his present office of vice-president of the Titan Iron & Steel Co., Inc.

The Wilson Welder & Metals Co., Inc., 132 King Street, New York, N. Y., recently appointed the King-Knight Co., Underwood Building, San Francisco, Cal., exclusive representatives in central and northern California for Wilson plastic-arc welding machines and Wilson "Color-Tipt" metals.

The Kelley Island Lime and Transport Co. has elected John A. Kling of Cleveland, Ohio, chairman of the board and George R. Johnson, of Buffalo, N. Y., president. Other officials elected include: E. W. Oglebay, first vice-president, F. A. Beckwith, second vice-president; G. J. Whelan, third vice-president and general manager; F. W. Ohlemacher, fourth vice-president, and C. A. McMorris, secretary and treasurer with F. W. Kohl as assistant secretary and assistant treasurer.

The Medart Patent Pulley Co., with general offices and works in St. Louis, Mo., has changed its name to The Medart Company.

Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa., announce a number of recent changes and transfers affecting several different departments as well as some of the district offices. T. A. McDowell has been appointed executive assistant to the manager of the supply department, which was recently reorganized. Carl G. Schluederberg, assistant to manager of the supply department, will hereafter devote all of his time to the foreign supply and merchandising business. W. C. Koehler has been appointed to succeed T. A. McDowell as manager of the cost and development section. M. H. Scott has been appointed chief clerk of the supply department. Paul H. Smith, manager of the power division of the Atlanta office, has resigned to accept a position with the Brooklyn Edison Co. He has been succeeded by Thomas Fuller, who is now manager of both the power and supply divisions of the Atlanta office. W. T. Blackwell has been appointed manager of the interior lighting section of the merchandising department with headquarters at South Bend, Ind. A. G. Crocker has been appointed manager of the power division of the Detroit office and R. J. Cobban has been made branch manager of the Butte office. W. W. Spangler has been appointed assistant manager of syndicate operations. Important changes have also been made in the power sales department. The changes include the promotions of three managers and the creation of two new managerships in the Power Department and are effective immediately. L. C. Bullington, who has been assistant to the manager of the power department for the past several years, has been made assistant manager and will have charge of the general work of the power department. Charles F. Lloyd, formerly manager of the substation section, has been made manager of the electric division and R. E. Carothers, formerly manager of the turbine section, has been appointed manager of the steam division. The vacancies caused by the promotions of Mr. Lloyd and Mr. Carothers have been filled by the elevation of Bruce H. Lytle and D. O. Tylee, the former becoming manager of the substation section and the latter manager of the turbine section.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold a summer excursion meeting to Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls and Buffalo, Aug. 13-19.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its 126th meeting at San Francisco, Calif., Sept. 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

ANNUAL SAFETY CONGRESS OF THE NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

THE SOCIETY OF INDUSTRIAL ENGINEERS will hold its next national convention and exhibitions of labor-saving equipment at the Hotel McAlpin, New York, Oct. 18, 19 and 20.